

Development of Hazardous Materials (HM) Shipper Prioritization Program

Final Report



U.S. Department of Transportation
Federal Motor Carrier Safety Administration

February 2009

FOREWORD

The purpose of this project was to review, document, and recommend improvements to the Federal Motor Carrier Safety Administration's (FMCSA's) Hazardous Materials (HM) Shipper Prioritization Program. This project developed a HM Shipper Prioritization Program web-based application. The purpose of this application was to assist FMCSA personnel in generating and prioritizing lists of shippers in certain regions that should be inspected or reviewed.

The work performed under the project included:

- Development and execution of a peer review plan
- Review and examination of previously completed work for the HM Shipper Prioritization Program
- Testing and implementation of a HM Shipper Prioritization Application
- HM Shipper Prioritization Application training session with key FMCSA personnel
- Project documentation and briefing

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or the use thereof.

The contents of this Report reflect the views of the contractor, who is responsible for the accuracy of the data presented herein. The contents do not necessarily reflect the official policy of the Department of Transportation.

This Report does not constitute a standard, specification, or regulation.

The United States Government does not endorse products or manufacturers named herein. Trade or manufacturers' names appear herein only because they are considered essential to the objective of this document.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Draft Final Report: Development of Hazardous Materials (HM) Shipper Prioritization Program		5. Report Date February 28, 2009	6. Performing Organization Code
7. Author(s) William A. Schaudt, Darrell Bowman, Andrew Marinik, Stephanie Baker, Tammy Trimble, and Richard J. Hanowski		8. Performing Organization Report No.	
9. Performing Organization Name and Address Virginia Tech Transportation Institute 3500 Transportation Research Plaza Blacksburg, Virginia 24061		10. Work Unit No. (TRAIS)	11. Contract or Grant No. VTRC # 08-0489-09 FMCSA # TMC75-07-H-00008 Task Order # 1
12. Sponsoring Agency Name and Address Department of Transportation Federal Motor Carrier Safety Administration Hazardous Materials Division West Wing, MC-ECH 1200 New Jersey Ave. SE Washington, DC 20590		13. Type of Report and Period Covered Final Report, January 1, 2008 – February 28, 2009	14. Sponsoring Agency Code FMCSA
15. Supplementary Notes This program was administered through the Federal Motor Carrier Safety Administration (FMCSA) and the Virginia Transportation Research Council (VTRC). The FMCSA AOTR is James Simmons and the VTRC Principal Investigator (PI) is Catherine McGhee.			
16. Abstract In the mid-1990s, an attempt was made to develop a performance-based prioritization for Hazardous Materials (HM) shippers. During this attempt it became apparent that there was insufficient performance data to develop such a system. In response, FMCSA developed the HM Package Inspection Program (HMPIP) to focus on inspecting individual shipments of HM at the roadside or on carriers' docks. Due to the improvements made over the years to the package inspection data collected during HMPIP inspections, HM incident data, and improved departmental data identifying companies involved in shipping HM, FMCSA has begun a second effort to develop a performance-based prioritization of HM shippers. The purpose of the current project was for the Virginia Tech Transportation Institute (VTTI) to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program. This project consisted of six major tasks, all of which were successfully executed by VTTI. After the kick-off meeting and the successful completion of a detailed work plan, a peer review committee was formed. Members of the peer review committee were to participate in two peer review meetings during the course of the project. The purpose of the first peer review meeting was to have the study methodology and data collection techniques reviewed by the committee. The purpose of the second peer review meeting was to review the study findings and conclusions. Another major step in this project was to review and examine the current Hazardous Materials (HM) Shipper Prioritization Program, which included two distinct prioritization algorithms, and to develop software titled the HM Shipper Prioritization Application (HMSPA). HMSPA was then beta tested in states with existing shipper programs. The focus of these onsite tests was usability testing with potential end users. Both subjective and objective data were collected by way of questionnaires and performance tasks. All results were very positive indicating that the beta version, with minor modifications based on user recommendations, should move forward into a fully functioning application for FMCSA.			
17. Key Words Hazardous Materials, Shippers, Inspect, Prioritization		18. Distribution Statement	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 147	22. Price N/A

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized.SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS					APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol	Symbol	When You Know	Multiply By	To Find	Symbol
<u>LENGTH</u>					<u>LENGTH</u>				
in	inches	25.4	millimeters	mm	mm	millimeters	0.039	inches	in
ft	feet	0.305	meters	m	m	meters	3.28	feet	ft
yd	yards	0.914	meters	m	m	meters	1.09	yards	yd
mi	miles	1.61	kilometers	km	km	kilometers	0.621	miles	mi
<u>AREA</u>					<u>AREA</u>				
in ²	square inches	645.2	square millimeters	mm ²	mm ²	square millimeters	0.0016	square inches	in ²
ft ²	square feet	0.093	square meters	m ²	m ²	square meters	10.764	square feet	ft ²
yd ²	square yards	0.836	square meters	m ²	m ²	square meters	1.195	square yards	yd ²
ac	acres	0.405	hectares	ha	ha	hectares	2.47	acres	ac
mi ²	square miles	2.59	square kilometers	km ²	km ²	square kilometers	0.386	square miles	mi ²
<u>VOLUME</u>					<u>VOLUME</u>				
fl oz	fluid ounces	29.57	milliliters	ml	ml	milliliters	0.034	fluid ounces	fl oz
gal	gallons	3.785	liters	l	l	liters	0.264	gallons	gal
ft ³	cubic feet	0.028	cubic meters	m ³	m ³	cubic meters	35.71	cubic feet	ft ³
yd ³	cubic yards	0.765	cubic meters	m ³	m ³	cubic meters	1.307	cubic yards	yd ³
<u>MASS</u>					<u>MASS</u>				
oz	ounces	28.35	grams	g	g	grams	0.035	ounces	oz
lb	pounds	0.454	kilograms	kg	kg	kilograms	2.202	pounds	lb
T	short tons (2,000 lbs)	0.907	megagrams	Mg	Mg	megagrams	1.103	short tons (2,000 lbs)	T
<u>TEMPERATURE (exact)</u>					<u>TEMPERATURE (exact)</u>				
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celsius temperature	°C	°C	Celsius temperature	1.8 C + 32	Fahrenheit temperature	°F
<u>ILLUMINATION</u>					<u>ILLUMINATION</u>				
fc	foot-candles	10.76	lux	lx	lx	lux	0.0929	foot-candles	fc
fl	foot-lamberts	3.426	candela/m2	cd/m2	cd/m2	candela/m2	0.2919	foot-lamberts	fl
<u>FORCE and PRESSURE or STRESS</u>					<u>FORCE and PRESSURE or STRESS</u>				
lbf	pound-force	4.45	newtons	N	N	newtons	0.225	pound-force	lbf
psi	pound-force per square inch	6.89	kilopascals	kPa	kPa	kilopascals	0.145	pound-force per square inch	psi

* SI is the symbol for the International System of Units. Appropriate rounding should be done to comply with Section 4 of ASTM E380.

TABLE OF CONTENTS

Foreword.....	iii
Notice.....	iii
ACKNOWLEDGEMENTS	xiii
ACRONYMS	xv
EXECUTIVE SUMMARY	xvii
Purpose.....	xvii
Process	xvii
Study Findings	xviii
Conclusions.....	xviii
1.0 INTRODUCTION.....	1
1.1 Organization of Current Report	2
2.0 DEVELOP AND EXECUTE A PEER REVIEW PLAN	5
2.1 Peer Review Meeting 1	5
2.2 Peer Review Meeting 2.....	7
3.0 REVIEW AND EXAMINE HM SHIPPER PRIORITIZATION PROGRAM.....	9
3.1 Review and Examine Documentation.....	9
3.2 Develop a Plan of Approach for Implementation.....	13
3.3 Perform Over-The-Phone User Interviews	15
3.4 Development of HMPSA.....	17
4.0 BETA TEST AND IMPLEMENT HM SHIPPER PRIORITIZATION PROGRAM.	23
5.0 REFERENCES.....	47
APPENDIX A: Slides Presented at Peer Review Meeting 1, Screening Questionnaire, Recruitment E-mail Template and Informed Consent Form	49
APPENDIX B: Slides Presented at Peer Review Meeting 2	67
APPENDIX C: Documentation of Algorithm 1	75
APPENDIX D: Documentation of Algorithm 2	83
APPENDIX E: Recruitment E-mail, Consent Form and User Interview #1 Guide.....	89

APPENDIX F: User Interview #2 Guide95

APPENDIX G: HM Shipper Severe Violations99

APPENDIX H: Usability Screening Questionnaire, E-mail Templates, Informed Consent Form, Protocol, Data Recording Sheet, Post Task Questionnaire, Post Task Interview, and Exit Questionnaire103

APPENDIX I: Table of Material Weighting Factors123

LIST OF TABLES

Table 1. Shipper A Scenario Attributes	11
Table 2. Shipper B Scenario Attributes	11
Table 3. Shipper C Scenario Attributes	12
Table 4. Shipper D Scenario Attributes	12
Table 5. Priority list generated for Algorithm 1 and Algorithm 2.....	12
Table 6. Comments Made During Performance Tasks and their Categorizations.....	32
Table 7. Comments Made During Performance Tasks and their Categorizations.....	32
Table 8. Other Comments and Questions Made During the Post-Task Interview.....	34
Table 9. Enforcement Score Variables and Associated Database Locations.....	42
Table 10. Inspection Score Variables and Associated Database Locations.....	43
Table 11. Incident Score Variables and Associated Database Locations	44

LIST OF FIGURES

Figure E1. Final HMSPA Home Page	xix
Figure E2. Final HMSPA Prioritization Selection Page	xx
Figure E3. Final HMSPA Prioritization Results Page	xxi
Figure E4. Final HMSPA About Algorithm Page (only portion of page shown).....	xxii
Figure 1. Home Page of the Beta Version of HMSPA	18
Figure 2. Prioritization Page of the Beta Version of HMSPA	19
Figure 3. Example of Results Page of the Beta Version of HMSPA.....	20
Figure 4. Dell Latitude D630 Laptop Computer Used in Beta Testing	24
Figure 5. Results Page from the Prioritization of the State of Florida used in Beta Testing	25
Figure 6. Results Page from the Prioritization of the Eastern Service Center Used in Beta Testing	26
Figure 7. Plot of Mean Time as a Function of Task	29
Figure 8. Question and Rating Scale Administered to each Participant After Completion of the First Task	29
Figure 9. Plot of Mean Difficulty Rating as a Function of Task	30
Figure 10. Plot of Mean Rating as a Function of Rating Question.....	31
Figure 11. Final HMSPA Home Page.....	37
Figure 12. Final HMSPA Prioritization Selection Page	38
Figure 13. Final HMSPA Prioritization Results Page	39
Figure 14. Final HMSPA About Algorithm Page (only portion of page shown).....	40

ACKNOWLEDGEMENTS

The authors of this report wish to thank James Simmons and Sandra Webb of the Federal Motor Carrier Safety Administration (FMCSA) for their constructive comments throughout this project. Mr. Simmons served as the Authorized Organizational Technical Representative (AOTR) and Ms. Webb served as the project manager. We also wish to thank other staff members at FMCSA who provided comments during the course of this work. We would like to thank Mike Perfater, Catherine McGhee, Cynthia Perfater, and other members of the Virginia Transportation Research Council (VTRC) for their support and oversight.

The authors thank individuals at the Virginia Tech Transportation Institute (VTTI) who contributed to the study in various ways: Sherri Cook, Brian Daily, Vikki Fitchett, and Clark Gaylord. This research was conducted under VTRC contract #08-0669-10 and FMCSA contract # TMC75-07-H-00008, Task Order No. 1.

ACRONYMS

AOTR	Authorized Organizational Technical Representative
CFR	Code of Federal Regulations
cm	centimeter
CMV	Commercial Motor Vehicle
COMPASS	FMCSA-wide IT modernization and business transformation program which stands for “Creating Opportunities, Methods, and Process to Secure Safety”
CSA	Comprehensive Safety Analysis
CSV	Comma Separated Values
DOT	Department of Transportation
DPI	Dots Per Inch
EMIS	Enforcement Management Information System
FMCSA	Federal Motor Carrier Safety Administration
HIP	HazMat Intelligence Portal
HM	Hazardous Materials
HMIRS	Hazardous Materials Incident Reporting System
HMIS	Hazardous Materials Information System
HMPIP	Hazardous Materials Package Inspection Program
HMSPA	Hazardous Materials Shipper Prioritization Application
HTML	Hyper Text Markup Language
IRB	Institutional Review Board
IT	Information Technology
MCMIS	Motor Carrier Management Information System
PHMSA	Pipeline and Hazardous Materials Safety Administration
PS	Prioritization Score
SD	Standard Deviation
SOW	Statement of Work
TRB	Transportation Research Board
VTRC	Virginia Transportation Research Council
VTTI	Virginia Tech Transportation Institute

EXECUTIVE SUMMARY

PURPOSE

The Hazardous Materials (HM) Shipper Prioritization Program has been under development at the Federal Motor Carrier Safety Administration (FMCSA) since the early 1990s. In the mid-1990s, an attempt was made to develop a performance-based prioritization for HM shippers, similar to a program by the name of SafeStat that was developed for carriers. During this attempt it became apparent that there was insufficient performance data to develop such a system. In response, FMCSA developed the HM Package Inspection Program (HMPIP) to focus on inspecting individual shipments of HM at the roadside or on carriers' docks. Data collected using HMPIP can be used as a helpful tool to establish lists of shippers in need of inspection. The program grew from less than 1,000 package inspections in 2001 to over 6,000 inspections in 2006. Due to the improvements made over the years to the package inspection data collected during HMPIP inspections, HM incident data, and improved departmental data identifying companies involved in shipping HM, FMCSA has begun a second effort to develop a performance-based prioritization of HM shippers.

In 2003, this second effort was initiated and was able to advance the project to the beta testing phase; however, for various reasons the project was halted. The purpose of the current project was to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program.

PROCESS

This study represents a comprehensive initial examination of FMCSA's HM Shipper Prioritization Program. From this point forward this report will refer to the HM Shipper Prioritization Program as the title of this project and will refer to the actual prioritization application as the HM Shipper Prioritization Application (HMSPA). The project included the following tasks:

- Task 1: Kick-off Meeting and Development of a Detailed Work Plan
- Task 2: Develop & Execute a Peer Review Plan
- Task 3: Review and Examine HM Shipper Prioritization Program
- Task 4: Beta Test and Implement HM Shipper Prioritization Application (HMSPA)
- Task 5: Submit Draft Final Report
- Task 6: Final Report, Technical Brief, and Training

All tasks were executed successfully. A kick-off meeting was held on January 14, 2008 at FMCSA headquarters. A work plan detailing the actions that VTTI would take to complete the project was completed. The development and execution of two peer review meetings occurred in Task 2. The purpose of the first peer review meeting was to have the study methodology and data collection techniques reviewed. The purpose of the second peer review meeting was to review the study findings and conclusions. All feedback and recommendations during this task by peer review members were found very useful in the development process of HMSPA. All previous work completed by FMCSA related to the project was examined, and a beta version of HMSPA was developed. Beta testing was performed in states with existing shipper programs. The focus of these on-site tests was usability testing with potential end users. Both subjective and

objective data were collected by way of questionnaires and performance tasks. All results were very positive indicating that the beta version, with minor modifications based on user recommendations, should move forward into a fully functioning application for FMCSA. The final deliverables for this project included this final report outlining the procedures used to develop HMSPA, a technical brief outlining the development details of HMSPA, and a paper summarizing the study results for submission to the Transportation Research Board (TRB) annual meeting. However, due to the timing of the TRB annual meeting the paper will have to be submitted for the 2010 meeting. VTTI also provided an oral presentation to FMCSA with a synopsis of the HM Shipper Prioritization Program. A written instruction manual on HMSPA was provided and VTTI presented one training session on the use of the new program to selected FMCSA personnel.

STUDY FINDINGS

Key findings from the beta testing of HMSPA are as follows:

- All participants successfully completed all tasks
- Each task was completed by participants in under 2 min (a task which would normally take from 2 to 5 days without HMSPA according to participants)
- All opinion ratings by participants were very high indicating the design of the beta version was intuitive and easy to use
- All comments during performance tasks were positive
- Modifications to HMSPA were made based on participant recommendations

CONCLUSIONS

After the final modifications were made, the final HMSPA delivered to FMCSA consisted of four web pages.

- 1) Home Page (figure E1)
- 2) Prioritization Selection Page (figure E2)
- 3) Prioritization Results Page (figure E3)
- 4) About Algorithm Page (figure E4)



Hazardous Materials Shipper Prioritization Application (HMSPA)

[Home](#) [Selection](#) [Results](#) [About Algorithm](#)

HMSPA

Login

Please enter your username and password to access the prioritization tool.

Username:

Password:

If you are having trouble logging into the system, you will need to contact your system administrator.

[Who is my system administrator?](#)

The Hazardous Materials Shipper Prioritization Application (HMSPA) is a tool created to help FMCSA personnel generate a list of hazardous materials shippers that need to be inspected. A unique algorithm has been developed which applies information from four databases in order to prioritize shippers based on certain parameters selected by the user of this tool (e.g. by state, service center area, etc.). The prioritization algorithm obtains information from the following four databases:

HMPIP - Hazardous Materials Package Inspection Program

MCMIS - Motor Carrier Management Information System

EMIS - Enforcement Management Information System

HMIRS - Hazardous Materials Incident Reporting System

Further information describing the algorithm and how it works is located on the About Algorithm page.

*It is important to note that this application should be used as a tool in combination with other methods for investigating potential HM Shippers in need of inspection and review. Because not all HM Shippers are in the databases, the results table generated by HMSPA will not contain all the HM Shippers that are in a geographical area

Feedback

The accuracy and usefulness of this tool depend on the users. Your feedback allows constant improvements to this tool. Those in the field are the most knowledgeable of the shippers and carriers being inspected. Please offer any comments you feel can better this tool for all.

(C)FMCSA October, 2008

Figure E1. Final HMSPA Home Page



Hazardous Materials Shipper Prioritization Application (HMSPA)

[Home](#) [Selection](#) [Results](#) [About Algorithm](#)

Prioritization Selection



The region you select will prioritize the shippers in that region. Please click on your region of interest on the map above or you can manually select states and territories from the choices below. Each shipper/carrier with a listed address in the selected regions will be added to the prioritization query. Once you have completed selecting the locations of interest, please click the submit button.

West

- Alaska
- American Samoa
- Arizona
- California
- Colorado
- Guam
- Hawaii
- Idaho
- Montana
- Nevada
- New Mexico
- North Dakota
- Northern Marianas
- Oregon
- South Dakota
- Utah
- Washington
- Wyoming

Midwest

- Arkansas
- Illinois
- Indiana
- Kansas
- Iowa
- Minnesota
- Michigan
- Missouri
- Nebraska
- Ohio
- Wisconsin

East

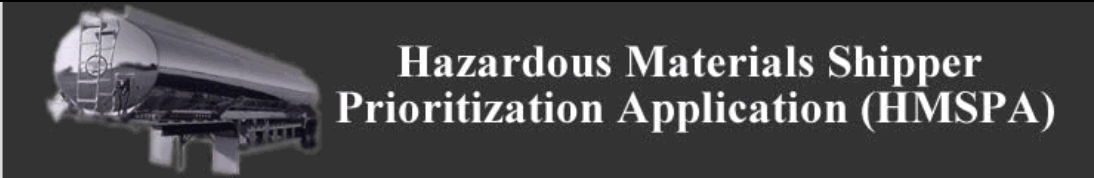
- Connecticut
- Delaware
- District of Columbia
- Maine
- Maryland
- Massachusetts
- New Hampshire
- New Jersey
- New York
- Pennsylvania
- Puerto Rico
- Rhode Island
- Vermont
- Virgin Islands
- Virginia
- West Virginia

South

- Alabama
- Florida
- Georgia
- Kentucky
- Louisiana
- Mississippi
- North Carolina
- Oklahoma
- South Carolina
- Tennessee
- Texas

(C)FMCSA October, 2008

Figure E2. Final HMSPA Prioritization Selection Page



Hazardous Materials Shipper Prioritization Application (HMSPA)

[Home](#) [Selection](#) [Results](#) [About Algorithm](#)

Prioritization Results

Note that the cells shaded RED indicate that multiple company names contributed to that row's priority ranking. View these individual company names by placing your mouse's pointer on the red cell and clicking the right mouse button.


Priority	Company Name	Address	City	State	Zipcode	Phone	US DOT
2				MD	20781		
3				VA	22630		
4				MD	21851		
5				MD	21218		
6				VA	24015		
7				WV			
8				VA	24032		
9				WV	26146		
10				VA	22801		
11				VA	23320		
12				VA	23709		
13				VA	23297		
14				VA	23681		
15				VA	23665		
16				MD	20755		
17				VA	24501		
18				VA	23701		
19				VA	23237		
20				MD	210171229		
21				MD	21222		

Identifying Information
Blurred for Confidentiality

Save As Excel Spreadsheet

(C)FMCSA October, 2008

Figure E3. Final HMSPA Prioritization Results Page



Hazardous Materials Shipper Prioritization Application (HMSPA)

[Home](#)
[Selection](#)
[Results](#)
[About Algorithm](#)

ALGORITHM

The prioritization of shippers utilized an algorithm developed by ABSC Consulting and modified by VTTI. As you recall, the algorithm uses a shipper's past performance as a predictor of risk. There are three distinct categories of shipper performance evaluated: Enforcements, Inspections, and Incidents. Each category was further broken down into several variables: severity, how recent, material involved, and frequency. The overall goal was to use this information specific to a given shipper to determine the likelihood of a violation or incident in the future. Those shippers with the calculated highest risk of future incident were assigned the highest priority, and those with the lowest risk were assigned the lowest priority. Thus, the Prioritization Score (PS) is calculated as the sum of each individual score:

$$\text{Prioritization Score} = ES + I_N S + I_T S$$

Where: *ES* = Enforcement Score

I_NS = Inspection Score

I_TS = Incident Score

The Enforcement Score largely uses the EMIS database, the Inspection Score uses the HMPIP as its data source, and the Incident Score is primarily based on data from the HMIRS. As this algorithm is designed to aid inspectors in utilizing vast amounts of information to more accurately target shippers of greater risk, this score is directly proportional to the risk of a given shipper. As such, the higher the prioritization score, the greater the priority.

ENFORCEMENT SCORE

As stated above there are three main categories of shipper history evaluated. The first is the

Figure E4. Final HMSPA About Algorithm Page (only portion of page shown)

The Home page contained a login box, a place to enter feedback for the system administrator, and a description and purpose of HMSPA. The purpose of the Prioritization Selection page was for users to select geographic regions in the United States and its territories and then generate a prioritization list of shippers for that region. The prioritization list was displayed in a table on the Prioritization Results page. This table was interactive and contained a list of shippers ranked, and also listed contact information such as company name, address, phone number, etc. The About Algorithm page contained detailed information regarding the algorithm used to calculate prioritizations of shippers.

In conclusion, HMSPA has been delivered to FMCSA along with appropriate development documentation for implementation within the FMCSA network. Further investigation of the performance of HMSPA in the field should be performed, as well as an assessment of algorithm design.

1.0 INTRODUCTION

The Hazardous Materials (HM) Shipper Prioritization Program has been under development at the Federal Motor Carrier Safety Administration (FMCSA) since the early 1990s. Traditionally, FMCSA's shipper program has been driven by complaints. In the mid-1990s, an attempt was made to develop a performance-based prioritization for HM shippers, similar to a software program by the name of SafeStat developed for carriers. During this attempt it became apparent that there was insufficient performance data to develop such a system. In response, FMCSA developed the HM Package Inspection Program (HMPIP) to focus on inspecting individual shipments of HM at the roadside or on carriers' docks. HMPIP is a browser-based software application used during dock and vehicle inspections to record compliance problems with HM packages. This software program can operate as a field system or via a central site. In the stand-alone mode, the data collected while offline is moved to the central site once a network connection is re-established. Data collected using HMPIP can be a helpful tool to establish shipper prioritization lists. FMCSA's annual National Shipper Check strike force activity focuses on using HMPIP to conduct inspections of many packages and reviews on shippers of HM. The program grew from less than 1,000 package inspections in 2001 to over 6,000 inspections in 2006. Due to the improvements made over the years to the package inspection data collected during HMPIP inspections, HM incident data, and improved departmental data identifying companies involved in shipping HM, FMCSA has begun a second effort to develop a performance-based prioritization of HM shippers.

In 2003, this second effort was initiated and was able to advance the project to the beta testing phase; however, various issues arose and the project was halted. Accomplishments made by FMCSA prior to the halting of the project are shown below in chronological order:

1. Obtained data that would be used for development of the HM Shipper Prioritization Program. Examined various databases from Federal, State, Industry, and other HM databases and formulated a standard structure for establishing the Shipper Prioritization Program. FMCSA's internal software applications were examined, such as: Hazardous Materials Information System (HMIS), Motor Carrier Management Information System (MCMIS), HMPIP, and other shipper-related information systems. FMCSA received recommendations on additional sources of shipper data to be included in the development of the HM Shipper Prioritization Program.
2. Developed the program and algorithm that would prioritize the shipper after close examination of the data and the other shipper information gathered. A current design for data structure was identified that is compatible with current FMCSA hardware/software in support of the HM Shipper Prioritization Program. The agency used its existing systems to incorporate a structure of prioritizing shippers that offer HM in transportation. When establishing the prioritization, FMCSA took into account the associated risks of the type of HM shipped. The current model of the software program ranks shippers based on the types of commodity, the shipper's frequency, a shipper's HMPIP violation summary, shipper's incidents, hazardous materials risks, roadside inspections, and other factors essential to the HM Shipper Prioritization Program. This program's algorithm took into

consideration various types of shipper operations; however, it would not prioritize by the operation without taking into consideration the overall operations of the shipper.

3. FMCSA started the beta test of the HM Shipper Prioritization Program; however, it was not corrected and ultimately not implemented because the analysis of the program had not been completed. Software was developed that conducted a basic analysis of the shipper information within the system; however, it was limited in performing analyses of HM shippers on a quarterly, semi-annual, and annual basis.

The purpose of the current project was to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program. From this point forward this report will refer to the HM Shipper Prioritization Program as the title of this project and will refer to the actual prioritization application as the HM Shipper Prioritization Application (HMSPA).

1.1 ORGANIZATION OF CURRENT REPORT

The current report details tasks completed in this project. These are briefly described in this section so that the reader can understand the logical progression of events that took place in completing the project.

Develop & Execute a Peer Review Plan

This project included the development and execution of two peer review meetings. VTTI conducted the first meeting with four subject-matter experts and the second meeting with two subject-matter experts. These subject-matter experts included Hazardous Materials Program Managers in charge of the oversight of inspecting and reviewing shippers for FMCSA. The same subject-matter experts included in the first peer review meeting were invited to participate in the second peer review meeting. These participating subject-matter experts formed the Subject-Matter Expert Committee. VTTI coordinated with the FMCSA AOTR during the Subject-Matter Expert Committee selection process and all selections were approved by the FMCSA AOTR. These meetings were held in the form of a webinar/teleconference. The purpose of the first peer review meeting was to have the study methodology and data collection techniques reviewed. The purpose of the second peer review meeting was to review the study findings and conclusions. Feedback obtained from the committee during the second meeting is reported in Section 4.2.5.2 of the current report. The information obtained from the committee presented in that section is primarily focused on recommendations for improvements.

Review and Examine HM Shipper Prioritization Program

VTTI reviewed and examined the previous work completed by FMCSA on HMSPA and developed a plan of approach to fully implement this application within FMCSA. This plan of approach was presented to the FMCSA AOTR via a webinar. Upon request of the FMCSA AOTR, the plan was slightly modified, stipulating one change that Beta Testing be performed with an off-line working version of the application, not a fully functioning application that had already been integrated into FMCSA.

Beta Test and Implement HMSPA

The purpose of this task was to beta test and implement HMSPA in states with an existing shipper inspection program. This allowed an opportunity to correct and enhance application features based on user input. The focus of these on-site tests was usability testing with potential end users. The targeted users were all field personnel in the field. Both subjective and objective data were collected by way of questionnaires and performance tasks. VTTI performed these usability tests with a total of five participants in five states with an existing shipper inspection program. These states were Idaho, Georgia, Minnesota, South Dakota, and Virginia. After results from the beta testing were examined, and feedback from the final peer review meeting were reviewed, final modifications were made to HMSPA. The final HMSPA software files and all supporting information relating to the development of the application were delivered to FMCSA.

2.0 DEVELOP AND EXECUTE A PEER REVIEW PLAN

This project included the development and execution of two peer review meetings. VTTI conducted the first meeting with four subject-matter experts and the second meeting with two subject-matter experts. These subject-matter experts included HM Program Managers in charge of the oversight of inspecting and reviewing shippers for FMCSA. The same subject-matter experts included in the first peer review meeting were invited to participate in the second peer review meeting, however only two experts were able to participate. These participating subject-matter experts formed the Subject-Matter Expert Committee. VTTI coordinated with the FMCSA AOTR during the committee selection process and all selections were approved by the FMCSA AOTR. These meetings were in the form of a webinar or teleconference, depending on the technology available to the individual committee members at that time. Before beginning the recruitment process for committee selection, approval from the Virginia Tech IRB was obtained for all project-related procedures including human participants.

2.1 PEER REVIEW MEETING 1

2.1.1 Overview

The purpose of the first peer review meeting was to have the study methodology and data collection techniques reviewed by the committee. During the committee selection process, information regarding computer, internet, and teleconferencing capabilities were obtained in order to organize and execute the meetings efficiently.

2.1.2 Method

The first meeting was executed similar to a kick-off meeting to provide background information on the project, as well as methodology and data collection techniques. This information was provided to the committee via a PowerPoint presentation in the form of a webinar. (A webinar is an internet-based web conferencing application that allows remote users to log in to an internet site and view presentations, conduct meetings and discussions, share applications, and post feedback.) This conferencing method was efficient and practical for sharing ideas and soliciting feedback. Prior to the meeting, all committee members were mailed a hard copy of this presentation. This allowed each committee member to review the presentation before the meeting. If any committee members did not have the ability to participate via webinar, they were given the choice to participate via telephone and use their PowerPoint hard copies as a reference (this occurred during the first peer review meeting with one participant). All committee members were allowed to provide verbal feedback during any point of this meeting. For accuracy assurance, the meeting was audio recorded. VTTI also collected feedback via e-mail from the committee members for one week after the meeting. After one week had passed, a letter report of the meeting minutes and comments provided were e-mailed to the committee members. All committee members were notified that he or she would be contacted in the following few months to participate in user interviews. Committee members were told to notify VTTI after the meeting if they did not want to participate in any user interviews. PowerPoint presentation slides for this meeting as well as the screening questionnaire, consent form, and e-mail template used for committee recruitment can be found in Appendix A.

2.1.3 Results and Discussion

The presentation began with a short discussion on the background of the project. This included details of the increase of available performance data over the years, and accomplishments made by FMCSA toward the development of the shipper prioritization program. The purpose of the current project was stated as follows: *The purpose of this research is to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program.*

Many helpful comments and suggestions were made by the committee members. Notable comments and suggestions are briefly summarized and described by the authors below:

- A member suggested that VTTI investigate work performed by Mr. Robert Brown (former HM Program Manager) in regards to shipper check statistics which were put together into an annual report. The information provided in that annual report was mentioned as a possibly helpful source and could probably be delivered to VTTI by James Simmons.
- A member suggested that VTTI should investigate other databases other than just the HMPIP. For example, the Pipeline and Hazardous Materials Safety Administration (PHMSA) was said to house enforcement databases that contain data on different shippers that could be very helpful in the project. Mr. Schaudt indicated that an algorithm had not yet been chosen to move forward with for HMSPA, and therefore the process of determining which databases to be utilized for the algorithm to calculate scores appropriately would be easier to determine when the best algorithm had been identified.
- All committee members agreed to participate in two over-the-phone user interviews during the design and development process of HMSPA.
- A member mentioned that PHMSA can supply weekly HM incident reports that have shipper incidents for the states of interest.
- All committee members indicated there was no current procedure to identify all of the shippers as shippers are not required to register, so most members of the committee and those employees working with them are prioritizing shippers with whom they just happen to make contact. In the future, requiring all shippers to register would be helpful for remedying this problem.
- One database for retrieving information vital for this project may be the Hazmat Intelligence Portal (HIP) because shippers register there. Also contacting PHMSA may be helpful as they have inspectors that are mining those databases as well.

2.2 PEER REVIEW MEETING 2

2.2.1 Overview

The purpose of the second peer review meeting was to present study findings and conclusions to the committee. The information obtained from the committee was primarily focused on conclusions and recommendations for improvements.

2.2.2 Method

This second meeting followed very similar procedures as described in the first peer review meeting. A brief description of the meeting content is presented here (see Section 4.2.5.2 for the full description) as the meeting was held after beta testing was completed. Three application screenshots were shown to those in attendance and explained how to use HMSPA to prioritize lists based on chosen parameters. Next, the methodology and results of the beta testing were presented. PowerPoint presentation slides for this meeting can be found in Appendix B. All members were notified that there would be minor changes made immediately to the application, which included changes such as increases in font size, the addition of columns to the results table, etc.

2.2.3 Results and Discussion

The presentation began with a short summary of the project. The purpose of the current project was stated as follows: *The purpose of this research is to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program.*

Many helpful comments and suggestions were made by the committee members. The committee expressed their satisfaction with how the project had been designed and executed. These members also expressed their hopes that whatever group at FMCSA ultimately would be responsible for implementing HMSPA will coordinate with the HM program managers who will be involved in its use. (As previously mentioned, detailed results will be discussed later in this report).

3.0 REVIEW AND EXAMINE HM SHIPPER PRIORITIZATION PROGRAM

VTTI reviewed and examined the previous work completed by FMCSA on the HM Shipper Prioritization Program and developed a plan of approach to fully implement HMSPA within FMCSA. This section will describe four major efforts undertaken by VTTI to meet the requirements of Task 3. Each effort is listed below and labeled by section number:

3.1 Review and examine documentation delivered to VTTI from FMCSA regarding previous work done in the program.

3.2 Develop a plan of approach for implementation of a fully functional HM Shipper Prioritization Program web-based application (HMSPA) within FMCSA.

3.3 Perform over-the-phone user interviews with members of the Subject-Matter Expert Committee for guidance in the development of HMSPA.

3.4 Development of HMSPA.

3.1 REVIEW AND EXAMINE DOCUMENTATION

An important first effort undertaken by VTTI was to examine the previously developed algorithms to be used in the prioritization of shippers. Two documents were delivered to VTTI by FMCSA on February 7, 2008 (Appendix C & D). Each document contained information regarding an algorithm designed for the prioritization of shippers. This section describes the process used by VTTI to examine each algorithm, the results obtained, and the final recommended algorithm proceeded with in the project.

3.1.1 Algorithm Descriptions

As mentioned previously, two algorithms were found in the documentation delivered to VTTI by FMCSA. Because VTTI was unfamiliar with the development of the algorithm from previous projects, it was difficult to determine which of these algorithms was the most recent and, therefore, should be the algorithm incorporated into HMSPA. Mr. Schaudt discussed this issue with Sandra Webb and she recommended that VTTI examine each of these algorithms as part of the review process and determine which algorithm would be most appropriate to move forward with for the project.

Algorithm 1

The first algorithm to be discussed was found in a document delivered to VTTI by FMCSA and is located in Appendix C. The algorithm, which is provided in Appendix C, will be referred to as *Algorithm 1* for the remainder of this report. This algorithm has the purpose of reporting a final *Shipper Priority Score*. The sum of three types of transportation risk measures results in the shipper priority score. The three types of measures are below:

- 1) Enforcement
- 2) Inspection
- 3) Incident

Therefore, Algorithm 1 can be characterized as shown in Equation 1 below:

$$\text{Shipper Priority Score} = \text{Enforcement Score} + \text{Inspection Score} + \text{Incident Score} \quad \text{Eq. 1}$$

Algorithm 2

The second algorithm, which is provided in Appendix D, was originally written by ABS Consulting and dated January 5, 2005. This algorithm will be referred to as *Algorithm 2* for the remainder of this report. This algorithm has the purpose of reporting a final *Shipper Priority Score*. The weighted sum of three types of transportation risk measures results in the shipper priority score. The three types of measures are below:

- 1) Incidents
- 2) Enforcement
- 3) Shipments

Therefore, Algorithm 2 can be characterized as shown in Equation 2 below:

$$\begin{aligned} \text{Shipper Priority Score} = & (\text{Incident Score} \times \text{Incident Weighting}) + \\ & (\text{Enforcement Score} \times \text{Enforcement Weighting}) + \\ & (\text{Shipment Score} \times \text{Shipment Weighting}) \end{aligned} \quad \text{Eq. 2}$$

Differences between Algorithms

While there were numerous differences between the algorithms, the most notable was the difference between the set of three transportation risk measures used by each algorithm. Also note that although each algorithm contained both Enforcement and Incident measures, each measure was calculated differently within each algorithm. Because Algorithm 1 and Algorithm 2 contained different sets of risk measures, and those measures that appeared to be the same actually were not, comparing the algorithms became a much more difficult task. For these reasons, a decision was made to develop an HM Shipper Prioritization *Prototype* using a spreadsheet program (Microsoft Excel 2007). This prototype had the capability of generating shipper priority scores for each algorithm based on fictional shipper scenarios created by VTTI personnel.

3.1.2 Method of Algorithm Examination

The first step in developing the prototype was to closely examine how each risk measure was calculated for each algorithm based on the documentation. These measures were then re-created in the prototype. Both algorithms prioritized shippers based on risk. The documentation defined risk as the combination of the frequency of a potential release and the consequence of a potential release. This risk is calculated based on the collective information of past inspections, incidents, and the enforcement actions required of each. Each algorithm proposed a separate method of

determining the risk associated with each shipper. Algorithm 1 combined a shipper’s inspection history, incident history, and enforcement history over a defined timeframe to establish priority. Algorithm 2 combined a shipper’s incident history, enforcement history, and shipment history. Algorithm 2 replaced the inspection history for a given shipper with a shipping history to evaluate the risk associated with the types of shipments within that shipper’s past. Algorithm 2 also added a normalization aspect to each score. This was intended to account for the variation in number of annual shipments per company.

The next step was to implement fictional shipper scenarios into the prototype. Each description below contains a 12-month inspection, incident, and enforcement history for a fictional shipper. Each unique shipper description has a table providing important numbers for consideration in the algorithm calculations. Each fictional shipper scenario was created with the final shipper priority score in mind. In other words, each shipper described below has an intended amount of risk associated in order to compare the overall priority for each algorithm. For example, Shipper B was given scenario attributes that would most likely put it at the highest priority for inspection, while Shipper D was given scenario attributes that would most likely put it at the lowest priority for inspection. Shipper A and Shipper C were given scenario attributes that were different from each other; however, each shipper ideally would still place somewhere in the middle of a priority list.

Shipper A

This fictional shipper had been inspected four times in the past 12 months, one of which resulted in a critical violation. Shipper A also had one serious incident in the last 12 months and was carrying Diethyl Ether (UN1155) at the time of the incident (table 1).

Table 1. Shipper A Scenario Attributes

Inspections	4 (1 Critical)
Incidents	1 (Serious)
Enforcements	1 (Critical)
Materials	Diethyl Ether
Shipments	58

Shipper B

This fictional shipper had been inspected 17 times in the past 12 months resulting in three critical violations and two other violations; the remaining 12 inspections occurred with no violations noted. Shipper B had no incidents in the past 12 months. The material of lading was propane (table 2).

Table 2. Shipper B Scenario Attributes

Inspections	5 (3 Critical, 2 Other)
Incidents	0
Enforcements	0
Materials	Propane
Shipments	114

Shipper C

This shipper had been inspected 12 times in the past 12 months resulting in no violations. Shipper C had two incidents in the past 12 months, one serious resulting in an “acute enforcement” action, the other minor resulting in an “other enforcement” action. The material of lading for both incidents was gasoline (UN1203) (table 3).

Table 3. Shipper C Scenario Attributes

Inspections	12 (None)
Incidents	2
Enforcements	2
Materials	Gasoline
Shipments	135

Shipper D

This shipper had been inspected seven times in the past 12 months. One inspection resulted in a critical violation. The material of lading was Sulfuric Acid (UN1830). Shipper D had no incidents or enforcements in the past 12 months (table 4).

Table 4. Shipper D Scenario Attributes

Inspections	7 (1 Critical)
Incidents	0
Enforcements	0
Materials	Sulfuric Acid
Shipments	86

3.1.3 Results

The priority list generated for each algorithm is shown below in table 5. Both algorithms had very similar results. As was hypothesized, Shipper B was clearly Priority Number 1, and Shipper D was clearly the lowest priority for both algorithms. The most interesting results were the differences in prioritization of Shipper A and Shipper C between each algorithm. Algorithm 1 ranked Shipper C as a higher priority than Shipper A, and Algorithm 2 ranked Shipper A as a higher priority than Shipper C.

Table 5. Priority list generated for Algorithm 1 and Algorithm 2.

Priority	Algorithm 1	Algorithm 2
1	Shipper B	Shipper B
2	Shipper C	Shipper A
3	Shipper A	Shipper C
4	Shipper D	Shipper D

Shipper A and Shipper C had very similar prioritization scores. However, results indicate that there are differences between the algorithms that can cause a small shift in the prioritization of shippers.

Algorithm 1

After closely examining these results, it was apparent that Algorithm 1 recognizes the risk of a shipper with a poor safety record. Essentially, Algorithm 1 prioritizes based upon shipper history. The prioritization score is heavily weighted on past inspection and incident violations and enforcement actions. This shows a bias toward consequence risk as it relates to hazardous materials shipments.

Algorithm 2

Algorithm 2 places a significant weight on the exposure of a given shipper. The emphasis is on the number of shipments and what materials are being shipped. The shipment score of Algorithm 2 accounts for almost the entire prioritization score in the aforementioned example.

3.1.4 Conclusions

Collectively, these results show that both algorithms have great promise. While each have their own structure for calculating priority scores, the end results seem to be very similar based on the examination outlined above. An important factor to consider when determining which algorithm to use is the availability of data from the appropriate databases. If data are not available for the number of shipments and the associated load descriptions for a shipper of interest, Algorithm 2 would unfairly bias larger shipping companies; that is, increase their ranking in the prioritization list. Based on this conclusion, and the results shown in this report, Algorithm 1 appeared to be the best candidate for *Task 3 (Review and Examine HM Shipper Prioritization Program)*.

3.2 DEVELOP A PLAN OF APPROACH FOR IMPLEMENTATION

This section will describe the plan of approach for development and implementation of HMSPA within FMCSA. This plan of approach was agreed upon by the FMCSA AOTR.

The full and successful implementation of HMSPA required completing four major phases. These phases included:

- Phase 1: Development of an off-line working version of HMSPA
- Phase 2: Beta testing of HMSPA
- Phase 3: Integration of HMSPA within the FMCSA network
- Phase 4: Final documentation and training

Each phase will be discussed in further detail below.

3.2.1 Phase 1: Development of an Off-line Working Version of HMSPA

The first phase consisted of developing a foundation and structure of HMSPA. VTTI exercised established human factors principles during the design and development of this application combined with feedback obtained from Subject-Matter Expert Committee user interviews. The goal of these interviews was to establish the expectations and requirements of the system as well

as to understand the tasks and steps that are currently performed to establish shipper inspection priority. Further details regarding these user interviews will be discussed in Section 3.3 of this chapter.

A teleconference was held between FMCSA personnel and VTTI to further discuss database access needs and Hyper Text Markup Language (HTML) coding and scripting constraints. The information obtained from this meeting indicated that a next major step was to obtain samples of data from four databases in order to integrate the algorithm properly into the application. These databases included HMPIP, MCMIS, Enforcement Management Information System (EMIS), and Hazardous Materials Incident Reporting System (HMIRS). The first three were databases controlled by FMCSA. The last database (HMIRS) was controlled by PHMSA.

After VTTI received samples of data from each database, the implementation of the algorithm into the application began. The plan was to receive database exports from each database so that multiple shippers could be prioritized for proper beta testing. That would allow enough data to properly test the application off-line/locally at VTTI.

3.2.2 Phase 2: Beta Testing of HMSPA

Usability testing is the most widely practiced user-centered design technique. The purpose of this phase was to test and implement HMSPA in states with existing shipper programs. This step provided an opportunity to correct and enhance features. The focus of these on-site tests was to perform usability testing with potential end users. Both subjective and objective data were collected by way of questionnaires, performance tasks, and by audio recording the sessions. A total of five participants in five different states with existing shipper programs were tested. Details regarding the design of the usability tests will be discussed in further detail in Section 4.0. Beta testing was designed to use the off-line version developed by VTTI. It was requested by the FMCSA AOTR that the application be updated and changed after results were obtained from the beta testing before it was delivered to FMCSA for implementation within the current Information Technology (IT) infrastructure.

3.2.3 Phase 3: Integration of HMSPA within the FMCSA Network

After VTTI completed the off-line version of HMSPA and made updates based on results from the beta testing, the next phase was to integrate the application within FMCSA. Full implementation of HMSPA would have to be performed within FMCSA. It was difficult to estimate the time it would take for FMCSA personnel to fully integrate the application into the network as VTTI personnel did not have enough knowledge and appropriate access to the FMCSA network. However, close communication was maintained by VTTI developers and FMCSA during the development process in order to increase the quality of the work as well as reduce the integration time for FMCSA.

3.2.4 Phase 4: Final Documentation and Training

The final deliverables for this project included this final report outlining the procedures used to develop HMSPA, a technical brief outlining the development details of HMSPA, and a paper summarizing the study results for submission to the Transportation Research Board (TRB) annual meeting. VTTI also provided an oral presentation to FMCSA with a synopsis of the HM Shipper Prioritization Program. A written instruction manual on HMSPA was provided and

VTTI presented one training session on the use of the new program to selected FMCSA personnel.

3.3 PERFORM OVER-THE-PHONE USER INTERVIEWS

After the first peer review meeting, committee members were given the opportunity to continue their voluntary participation in two follow-up user interviews over the telephone in Task 3 (Review and Examine HM Shipper Prioritization Program). Although this was not a primary responsibility of the committee members, VTTI considered it important to briefly discuss the purpose of these interviews in this section. A *User Interview* is a one-on-one session between an experimenter and a potential user to discuss the methods currently in place and their expectations of a future application (Bauersfeld, 1994). Bauersfeld identified three important research steps useful in the development and design of software: (1) implement user interviews before design begins, (2) implement user interviews and task analysis during the development cycle to evaluate development concepts, and (3) implement usability testing at the end of the development cycle to analyze the product's functionality. Steps 1 and 2 are the interviews that the committee members participated in. A different set of five participants were involved in Step 3 during Task 4 of this project (Beta Test and Implement HMSPA). VTTI researchers deemed it important to use the same members that participated in the committee for the user interviews because these committee members already had background knowledge of the project and application. The committee members were interviewed before software development began in order to understand a user's ultimate goals for use of HMSPA. The goal of this first set of interviews was to establish the expectations and requirements of the system as well as investigate the steps that were currently performed to establish prioritization lists of shippers. The second set of interviews was conducted during the development cycle in order to obtain feedback on the application interface design. Understanding these current steps combined with user feedback during the development of HMSPA was vital in the design process. The goal of both user interviews was to obtain information vital to creating a simple and intuitive step-by-step process for the end user.

3.3.1 User Interviews Before Design Begins

Four committee members were interviewed before design began in order to understand a user's ultimate goals and expectations of HMSPA as well as current steps and procedures used to generate lists of shippers to inspect. A user interview guide with detailed questions, recruitment e-mail template, and consent form are provided in Appendix E.

3.3.2 Implement User Interviews and Task Analysis During the Development Cycle to Evaluate Development Concepts

Three of the four committee members used in the previous step were also interviewed during the development cycle in order to obtain feedback on the application interface design. User feedback during the development of HMSPA was vital in the development process. Ultimately, the goal of this step was to obtain feedback in order to create a simple and intuitive step-by-step process for the end user. A user interview guide with detailed questions and web-based screenshots are provided in Appendix F.

3.3.3 Results

All comments and suggestions relevant to the development of HMSPA obtained during both user interviews will be presented in this section.

- **Log-in Credentials** – It was discovered that FMCSA personnel use many different credentials for logging in to software and web-based applications. The appropriate credentials for HMSPA should be identified and details presented on the log-in page. FMCSA will need to determine which credentials are appropriate during implementation within their network and add such a description to HMSPA.
- **Regions and States** – It was discovered that the regions portrayed in the map were incorrect and should be re-visited. These regions should be labeled by their names instead of by numbers (Midwestern Service Center, Western Service Center, Southern Service Center, and Eastern Service Center). Also, it was suggested that the list of states be presented in a column underneath the regional heading instead of alphabetical order. All changes suggested were executed by VTTI prior to beta testing.
- **Prioritization Results** – Although VTTI did not present a prioritization results table in the form of a web-based screenshot to the participants, questions were presented to obtain what information field agents would need in order to perform their jobs more efficiently.
 - Participants expressed the need to see Department of Transportation (DOT) numbers for shippers if they were available in any of the databases used. VTTI did not implement this before beta testing, however, did ultimately incorporate this in its own column in the results table in the final HMSPA delivered to FMCSA.
 - Participants expressed interest in being able to read further information on prior enforcement actions and violations in the results table. Although this information might be helpful to FMCSA personnel, it was deemed by researchers that this effort was out of the scope of the current project. VTTI does understand that field

agents would possibly be interested in how and why the prioritization score was calculated for a specific shipper, however, researchers believe that adding a page describing the algorithm in detail would be sufficient. VTTI did not add an algorithm page before beta testing, however, did ultimately incorporate the page in the final HMSPA delivered to FMCSA.

- It was suggested that any columns presented in the results table have the option to sort by the heading. Creating an interactive table with this option would allow field agents to sort by the city they are in and thus be much more efficient. This feature was implemented before beta testing.
 - All participants indicated that presenting any information regarding the address and location of a shipper was necessary. VTTI incorporated this into the table before beta testing.
 - It was suggested that a column be presented in the results table indicating the county that the shipper was located in. This was not incorporated into the site before beta testing. Researchers concluded that providing the City, State, and Zip code was sufficient information to include in the table and was the most readily available location information in the databases.
 - All participants indicated that presenting between 50 to 100 shippers in the results table would be sufficient. This was implemented before beta testing.
- ***Pure Shipper Versus Shipper/Carrier*** – A distinction between Pure Shippers and Shipper/Carriers was described by participants during the user interviews. According to participants, a Pure Shipper is an entity that only offers HM for transportation. They have to recruit a motor carrier to pick up and deliver the product. A Shipper/Carrier is an entity that manufactures and distributes its own products. The company has opted to transport its own goods. Participants indicated that if possible, it would be helpful to make this distinction in the results table. VTTI did not implement this before beta testing. VTTI could not find the location within the databases that contained this distinction.

Overall the user interviews were extremely successful in establishing the expectations and requirements of the system.

3.4 DEVELOPMENT OF HMPSA

The development effort was performed concurrently with many of the other previously described efforts. As previously mentioned, VTTI began developing a foundation and structure of the web-based application early in the project. VTTI exercised established human factors principles during the design and development of this application in combination with feedback obtained committee user interviews. This section will briefly describe the major development efforts performed by VTTI. A more detailed description of the final technical development process will be presented in Section 4.3.

The development of the beta version of HMSPA had the goal of creating three website pages; Home Page, Prioritization Page, and Results Page. These three were considered essential to develop for use in beta testing. The beta version of HMSPA was not an on-line working web-based application. It was off-line using locally-housed data. All three pages had the same title bar containing a logo of a HM cargo tank and the title “Hazardous Materials Shipper Prioritization

Application (HMSPA).” The Home page was created with a login area to the left, and a feedback box to the right for users to supply comments and recommendations. The main content of the Home page consisted of a brief description of the site and the databases used for calculating priority scores for shippers (see figure 1). The purpose of the Prioritization page was for a user to choose the geographic area to prioritize shippers by using a map to click service center areas, or by selecting each individual state of interest near the bottom (see figure 2). Finally, an interactive Results page was created to display the prioritized list of shippers generated from the Prioritization page. This results table contained seven different columns of information all of which a user could use to sort by. These columns were as follows; Priority Score, Company Name, Address, City, Zip, and Phone (see figure 3).



Figure 1. Home Page of the Beta Version of HMSPA



Hazardous Materials Shipper Prioritization Application (HMSPA)

[Home](#) [Prioritize](#) [Results](#) [About Algorithm](#)

Region

The region you select will prioritize the shippers in that region. Please click on your region of interest below:



You can also manually select states and territories. Each shipper/carrier with a listed address in the selected regions will be added to the prioritization query. Once you have completed selecting the locations of interest, please click the submit button.

West

- Alaska
- Arizona
- California
- Colorado
- Hawaii
- Idaho
- Montana
- Nevada
- New Mexico
- Oregon
- Utah
- Washington
- Wyoming

Midwest

- Arkansas
- Illinois
- Indiana
- Kansas
- Iowa
- Minnesota
- Michigan
- Missouri
- Nebraska
- North Dakota
- Ohio
- South Dakota
- Wisconsin

East

- Connecticut
- Delaware
- Maine
- Maryland
- Massachusetts
- New Hampshire
- New Jersey
- New York
- Pennsylvania
- Rhode Island
- Vermont
- Virginia
- West Virginia

South

- Alabama
- Florida
- Georgia
- Kentucky
- Louisiana
- Mississippi
- North Carolina
- Oklahoma
- South Carolina
- Tennessee
- Texas

Figure 2. Prioritization Page of the Beta Version of HMSPA

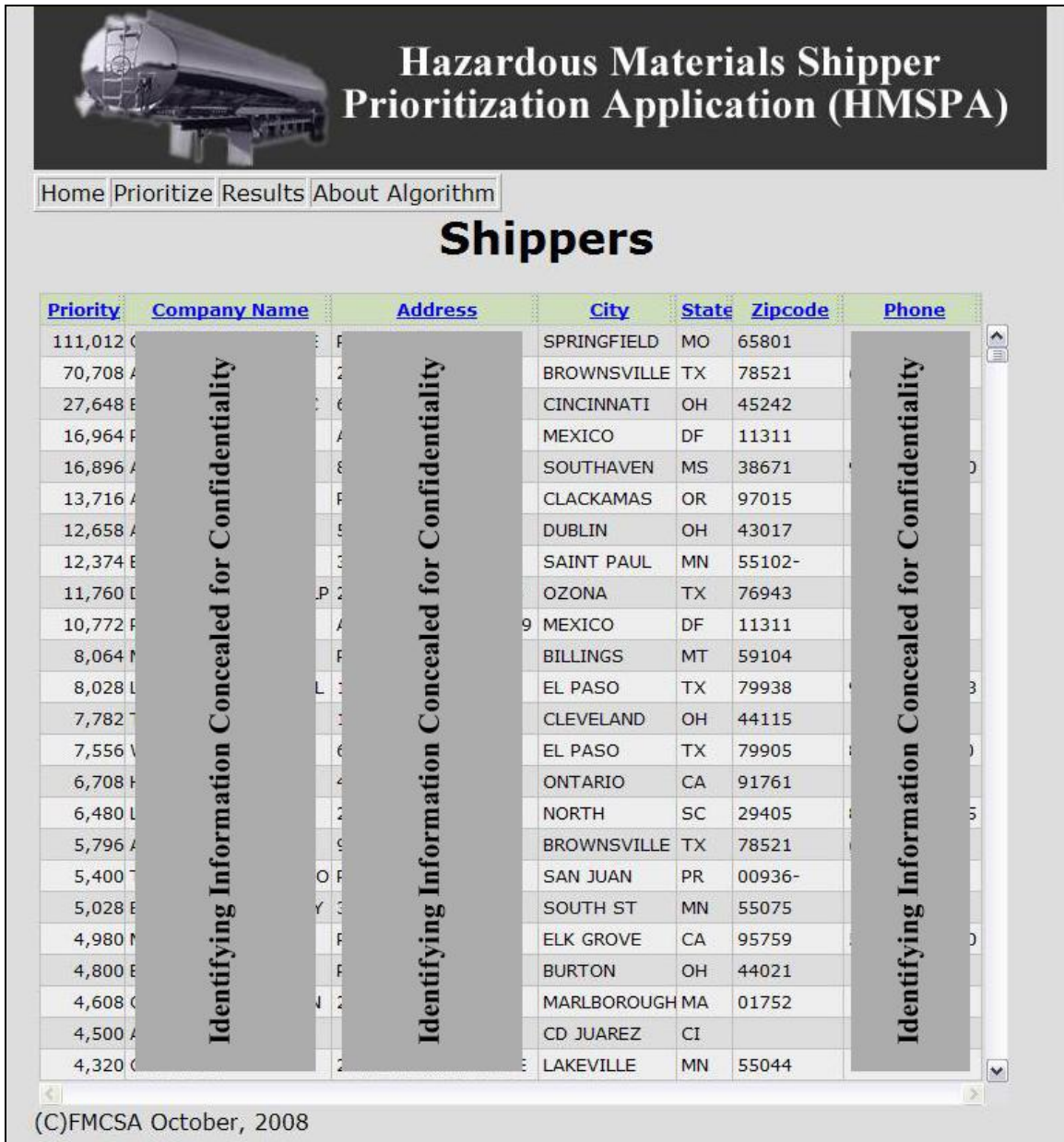


Figure 3. Example of Results Page of the Beta Version of HMSPA

The source of prioritization for HMSPA is an algorithm designed to evaluate the potential risk for an HM shipper. The algorithm used a shipper's historical information to extrapolate future risk characteristics. The algorithm required the combination of various data extracted from several databases for the same shipper, and thus, required a way to uniquely identify each shipper across databases. VTTI developed a method to filter shipper nomenclature within the source databases to ensure accurate score calculations. The algorithm utilized several data sources to calculate the necessary scores. In order for HMSPA to have successfully used this algorithm, VTTI had to organize the data in one central location for access. The original developers of the algorithm specified potential data sources. After further discussion with FMCSA personnel, the following databases were selected:

- HMPIP
- MCMIS
- EMIS
- HMIRS

The first three were databases controlled by FMCSA. The last database was controlled by PHMSA. After requesting direct access to these databases, both FMCSA and PHMSA were unable to grant access to VTTI. Instead, VTTI was provided a static export of the HMPIP and the MCMIS data; as well as a Microsoft Excel spreadsheet containing the results of a query against the EMIS database. Data from HMIRS was retrieved from the PHMSA Incident Reports Database Search web page on August 1, 2008 in CSV files which can be accessed at <https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/>.

The algorithm required the use of varying severity levels to calculate individual scores for a given shipper. These severity levels were based on Code of Federal Regulations (CFR) section numbers. Although most of the databases contained the CFR section numbers cited for a violation or enforcement action, they did not provide a level of severity. Therefore, VTTI requested clarification as to the level of severity for the various citations. This was provided by FMCSA in hardcopy form (Appendix G). After collecting all of the necessary data sources, VTTI began the process of creating locally-housed databases for use in the creation of the beta version of HMSPA. The HMPIP data export and MCMIS data export were directly imported as local databases. The HMIRS data, EMIS data, and Severity Level data were imported each as a single table. The HMIRS and EMIS data became single table databases. The severity level data was imported into the HMPIP database as an additional table.

Attributing the correct scores to a proper shipper was essential in creating an accurate prioritization score. Thus, as each score was calculated, it was assigned a unique identifier. It became clear when filtering and evaluating the data that the shipper name alone was insufficient to create this unique identity. The most frequent issue with shipper names was misspellings. This would cause the score associated with the misspelled shipper to be counted separately from the rest of the shipper's score. To prevent this from happening, VTTI created a unique identifier that allowed cross-database querying for a given shipper. To accomplish this goal VTTI used a technique called Soundex. Developed by Robert C. Russell, Soundex is a phonetic index created to match misspelled surnames (Lait & Randell, 1995). The principle behind Soundex is that the English language has certain letters easily confused with other letters or combinations of letters. The Soundex technique allowed similar names to be matched up with one another, even if placed far apart in a large listing. This technique was improved upon with the development of the American Soundex System. VTTI used the American Soundex System to abbreviate the shipper name and the shipper city. The abbreviations were then concatenated and the two-digit state code was added to create a unique identifier.

For example, a fictional shipper by the name of VTTI in Blacksburg, Virginia would have the unique identifier of:

VTTI = V300
Blacksburg = B421

Therefore, V300+B421+VA = V300B421VA.

A reliability test was performed by running the unique identifier creation query on all shippers in the locally housed HMIRS database. After creating the unique identifier, a random selection of 15 percent was chosen for manual verification. Manual verification consisted of checking both the shipper name for consistency and the unique identifier for accuracy. VTTI found that the unique identifier technique proved successful 98.84 percent of the time with a 95 percent Wald confidence interval of [98.35 percent, 99.33 percent](Agresti, 2002). The confidence interval was calculated by:

$$\hat{\pi} \pm Z_{\alpha/2} \sqrt{\frac{\hat{\pi}(1-\hat{\pi})}{n}} \quad \text{Eq. 3}$$

Where: $\hat{\pi}$ = Sample Proportion
 $Z_{\alpha/2}$ = z-value with an area of $\alpha/2$ to its right and left (obtained from a table).
n = Sample Size

Based on these results, VTTI used this technique to create unique identifiers for each shipper in all three databases (HMIRS, HMPIP, and EMIS) to accurately combine individual scores.

The prioritization of shippers utilized an algorithm developed by ABSC Consulting and modified by VTTI. As mentioned, the algorithm uses a shipper's past performance as a predictor of risk. There are three distinct categories of shipper performance evaluated: enforcements, inspections, and incidents. Each category was further broken down into several variables: severity, how recent, material involved, and frequency. The overall goal was to use this information specific to a given shipper to determine the likelihood of a violation or incident in the future. Those shippers with the calculated highest risk of future incident were assigned the highest priority, and those with the lowest risk were assigned the lowest priority. Thus, the Prioritization Score (PS) was calculated as the sum of each individual score:

$$\text{Prioritization Score} = ES + I_N S + I_T S \quad \text{Eq. 4}$$

Where: ES = Enforcement Score
 $I_N S$ = Inspection Score
 $I_T S$ = Incident Score

The Enforcement Score largely used the EMIS database, the Inspection Score used the HMPIP as its data source, and the Incident Score is primarily based on data from the HMIRS. Further details on how each score are calculated will be described in Section 4.3.

4.0 BETA TEST AND IMPLEMENT HM SHIPPER PRIORITIZATION PROGRAM

The purpose of this task was to beta test and implement HMSPA in states with an existing shipper program. This allowed an opportunity to correct or enhance features. The focus of these on-site evaluations was usability testing with potential end users. As previously defined, usability testing is the act of evaluating software by having targeted users actually work with it in a test situation (Bauersfeld, 1994). Both subjective and objective data were collected by way of questionnaires, performance tasks, and audio recordings of the sessions.

5.1 METHOD

4.1.1 Participants

VTTI performed these usability tests with five participants in five states with an existing shipper program. These states were Idaho, Georgia, Minnesota, South Dakota, and Virginia. Approval for participant experimentation for this project was approved by the Virginia Tech IRB Human Assurances Committee. All participants signed informed consent forms prior to involvement (see Appendix H). The age of participants ranged between 39 and 49 years old (mean of 45.8). The range of job experience for participants was between 4 and 22 years (mean of 12). Gender was not considered in selection of the participants. In the end, only male participants volunteered.

4.1.2 Apparatus

All usability testing was performed on a Dell Latitude D630 laptop computer with optical mouse (figure 4). The laptop was running Microsoft Windows XP Professional, Version 2002, Service Pack 3. The screen resolution was set to 1140 by 900 pixels and color quality was set at the highest level (32 bit). The graphics card driving the display was a NVIDIA Quadro NVS 135M. The DPI setting was normal at 96 DPI. The actual monitor size of the laptop was 19 cm high by 30.5 cm wide. The laptop was positioned on a desk or table, depending on the testing environment for each individual site. The screening questionnaire, e-mail templates, informed consent form, protocol, data recording sheet, post-task questionnaire, post-task interview, and exit questionnaire are provided in Appendix H. HMSPA was displayed on the laptop and usability testing software developed by Morae (version 3.0) was utilized for recording audio and time on task. All local web pages viewed by participants are shown in figures 1, 2, 3, 5, and 6.



Figure 4. Dell Latitude D630 Laptop Computer Used in Beta Testing



Hazardous Materials Shipper Prioritization Application (HMSPA)

[Home](#) [Prioritize](#) [Results](#) [About Algorithm](#)

Shippers

Priorit	Company Name	Address	City	State	Zipcode	Phone
1,440			TAMPA	FL		
792			WEST PALM	FL	33413	
504			BUNNELL	FL	32110	
252			MIRAMAR	FL	33025	
252			TALLAHASSEE	FL	32310	
216			ODESSA	FL	33556	
216			ODESSA	FL	33556	
210			JACKSONVILLE	FL	32216-	
192			MIAMI	FL	33178	
180			DEERFIELD	FL	33442	
144			ORLANDO	FL	32824	
144			E POMPANO	FL	33064	
144			RIVERA BEACH	FL	33404	
120			MIAMI	FL		
120			MULBERRY	FL	33860-	
80			MIAMI LAKES	FL	33014	
72			MEMPHIS	FL	38126	
60			DORAL	FL	33122	
60			ATLANTIC	FL	32233	
60			MIAMI	FL	33166	
48			WINTER	FL	32708	
36			FT	FL	33312	
36			MIAMI	FL	33169	
36			TAMPA	FL		

(C)FMCSA October, 2008

Figure 5. Results Page from the Prioritization of the State of Florida used in Beta Testing

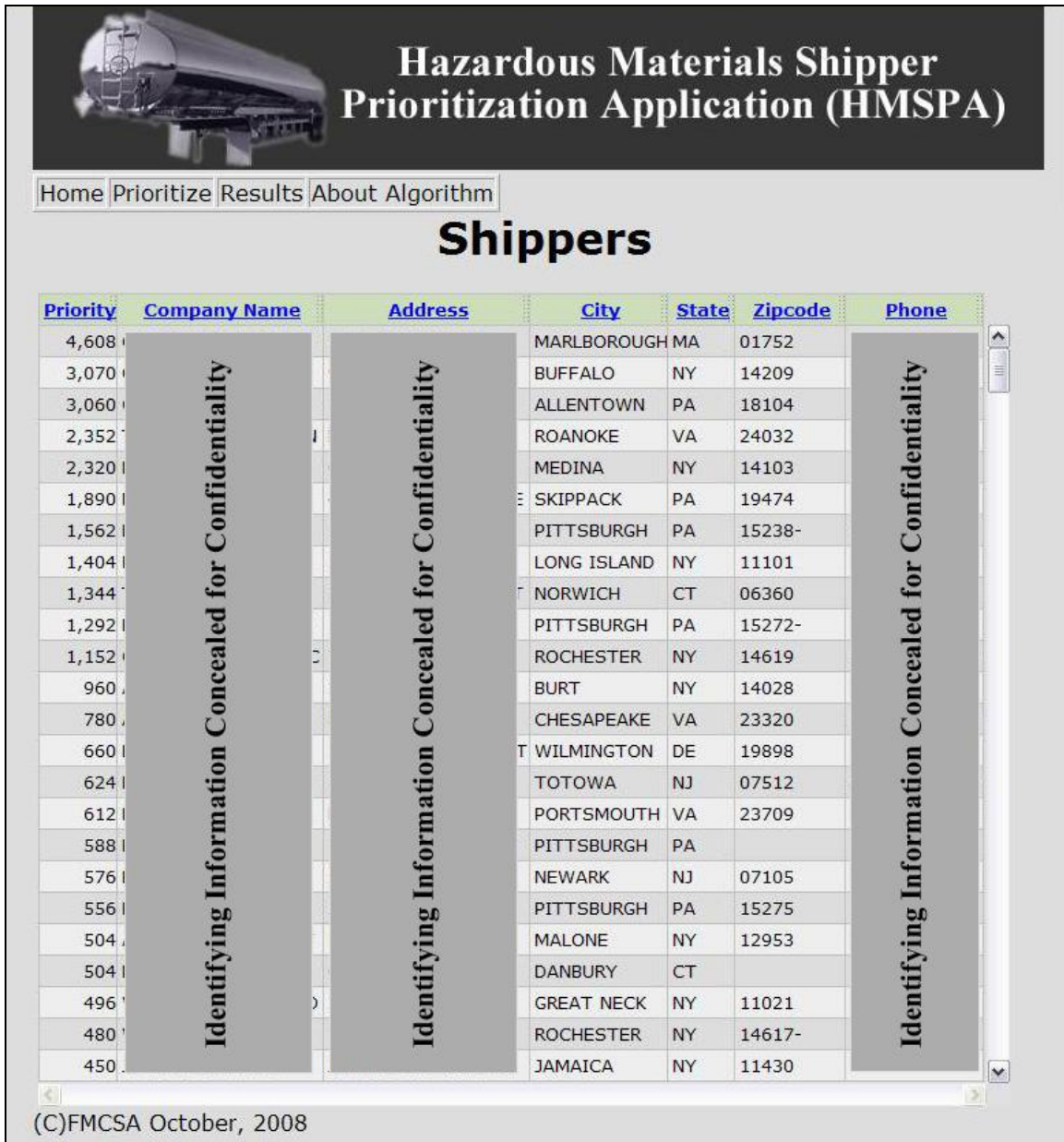


Figure 6. Results Page from the Prioritization of the Eastern Service Center Used in Beta Testing

4.1.3 Procedure

The cities visited by the VTTI experimenter were in the following order:

- 1) Minneapolis, MN
- 2) Boise, ID
- 3) Sioux Falls, SD
- 4) Richmond, VA
- 5) Valdosta, GA

At each site, procedures involving participants were executed identically with the exception of environmental differences such as the room/office in which the testing occurred as well as the desk/table on which the laptop was positioned. The only people present during the testing were the experimenter and the participant. Each participant was tested in one session lasting less than one hour. At the beginning of the study, the participant was greeted and asked to read and sign the informed consent form. A short project introduction was given by the experimenter and any participant questions were answered. The participants were then instructed to familiarize themselves with the Home page (figure 1) until they deemed their readiness to begin performing prioritization tasks. Three prioritization tasks were performed by each participant. Each task began on the Prioritization page (figure 2). Participants were instructed to take as long as needed and not to worry about making any mistakes. Participants were also instructed to perform each task without experimenter input or guidance and re-assured that after the task has been completed an opportunity to share any comments would be available. All mouse movements, button clicks, and audio were recorded in order to calculate task time, any mistakes made, as well as capture any comments made by each participant.

The objective of each task was for each participant to use the Prioritization page to create a prioritization list of shippers for an instructed geographical region. The geographical region for the first task was the state of Florida. The geographical region for the second task was the Eastern Service Center. The geographical region for the final task was the entire United States. After each task was finished, a post-task questionnaire consisting of one rating scale was given to each participant, as well as any follow-up questions necessary (see Appendix H). Upon the successful completion of each task, the Results page, which consisted of an interactive table, would be displayed. The experimenter would briefly describe the content of the table and its interactive capabilities (figure 3). After all tasks were completed, a final post-task interview and exit questionnaire were performed consisting of open-ended questions as well as additional rating scales (see Appendix H).

4.1.3.1 *Rating Scales*

All rating scales administered to participants are shown in Appendix H. These rating scales were intended to provide information on multiple parameters shown below:

- Difficulty (tasks individually and overall)
- Usefulness
- Satisfaction
- Reaction
- Arrangement
- Terminology
- Ability to Learn
- Correcting Mistakes

For analysis purposes, the rating scale responses were converted to numerical values. Each scale had nine vertical delineators. They were numbered from 1 on the left to 9 on the right. The middle of the scale was then numbered as a 5. A value of 5 would ordinarily correspond to a

“moderate” or “neutral” rating. Values greater than 5 would correspond to favorable ratings; conversely, values smaller than 5 would correspond to unfavorable ratings.

4.2 RESULTS

In general, the purpose of the usability testing was to evaluate HMSPA by collecting both objective and subjective data to correct or enhance features before implementation within FMCSA. The results section of this report will first provide descriptive statistics about the participants and the tasks performed. Next, results from the rating scales will be discussed. Finally, the numerous comments received from participants will be presented.

4.2.1 Participant and Task Descriptive Statistics

As previously mentioned, the age of participants ranged between 39 and 49 years old (mean of 45.8). The range of job experience for participants was between 4 and 22 years (mean of 12). Gender was not considered in selection of the participants. In the end, only male participants volunteered. Each participant successfully completed every task resulting in a 100 percent successful task completion rate. Each testing session ranged between 33 and 45 minutes (mean = 38.40, SD = 4.67). The mean time for the familiarization period and each individual performance task is shown in figure 7. The familiarization period for the Home page ranged between 55.40 and 221.09 s (mean = 104.20, SD = 70.65). The task of prioritizing a list of shippers by state ranged between 28.40 and 70.56 s (mean = 41.63, SD = 18.01). The task of prioritizing a list of shippers by service center ranged between 9.21 and 57.65 s (mean = 22.38, SD = 20.00). The task of prioritizing a list of shippers for the entire United States ranged between 12.60 and 25.82 s (mean = 17.33, SD = 5.00). Based on these results, without experimenter instruction on how to perform these prioritization tasks using HMSPA, it is possible for users to visit the site for the first time, familiarize themselves, and perform a prioritization task in less than 5 minutes.

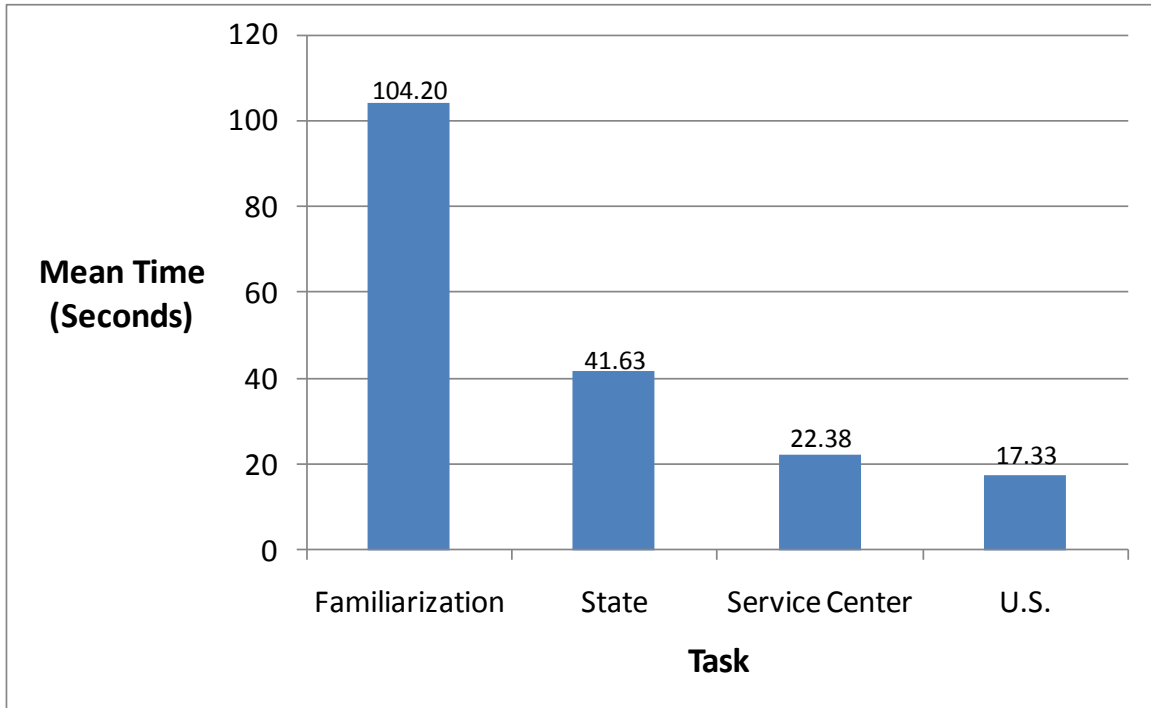


Figure 7. Plot of Mean Time as a Function of Task

4.2.2 Ratings

After each task, a rating scale was administered to each participant to judge the level of difficulty involved. For example, the question and rating administered for the first task is shown in figure 8.

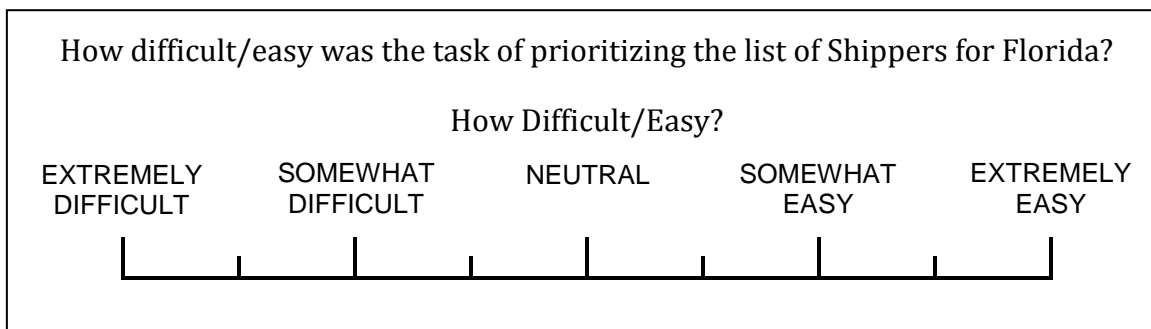


Figure 8. Question and Rating Scale Administered to each Participant After Completion of the First Task

As previously mentioned, the rating scale responses were converted to numerical values. Each scale had nine vertical delineators. They were numbered from 1 on the left (extremely difficult) to 9 on the right (extremely easy). The middle of the scale was then numbered as a 5. The mean difficulty rating for each performance task is shown in figure 9. The task of prioritizing a list of shippers by state ranged between a rating of 7 and 9 (mean = 8.4, SD = 0.9). The task of prioritizing a list of shippers by service center ranged between a rating of 8 and 9 (mean = 8.8, SD = 0.4). The task of prioritizing a list of shippers for the entire United States ranged between a

rating of 8 and 9 (mean = 8.8, SD = 0.4). Based on these results, researchers can conclude that all tasks were rated very high indicating that the tasks were very easy to perform.

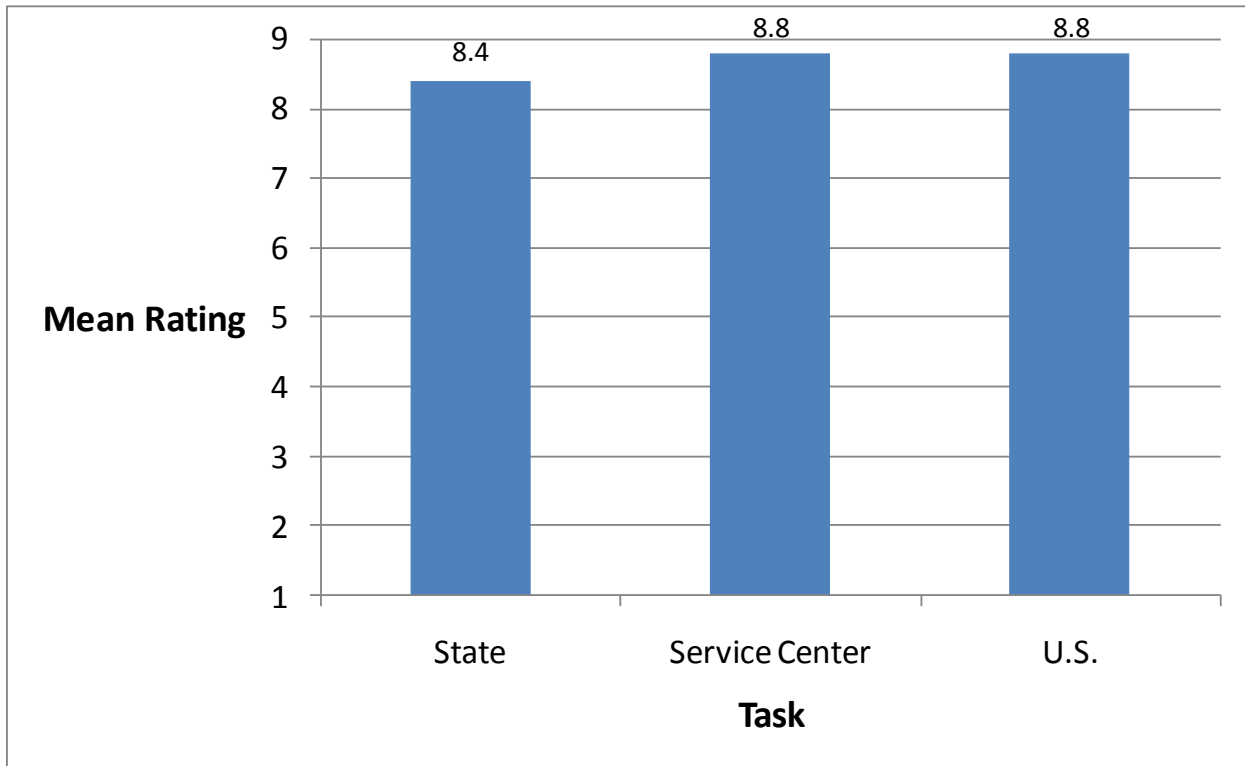


Figure 9. Plot of Mean Difficulty Rating as a Function of Task

Other rating scales were administered after the tasks were completed during the post-task interview and exit questionnaire (Appendix H). As previously mentioned, these rating scales were intended to provide information on multiple parameters shown below:

- Difficulty (tasks individually and overall)
- Usefulness
- Satisfaction
- Reaction
- Arrangement
- Terminology
- Ability to Learn
- Correcting Mistakes

The mean rating for each parameter is shown in figure 10. Based on these results, researchers can conclude that all parameters were rated very high indicating that the tasks were very easy to perform.

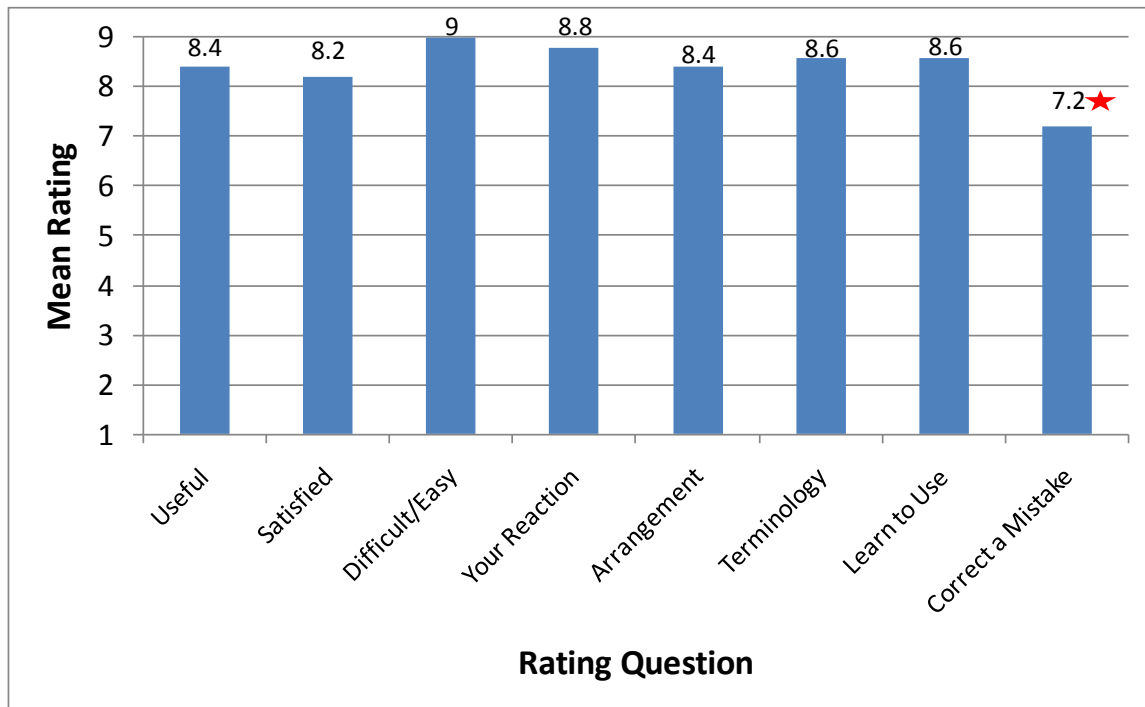


Figure 10. Plot of Mean Rating as a Function of Rating Question

It is important to note that the mean rating value of 7.2 for the difficulty of correcting a mistake (see star in figure 10) is misleading. At first glance it may appear that the task of correcting a mistake was more difficult than other parameters. The question presented for this parameter was, “What was your overall impression regarding the ability to correct your mistakes?” The mean value of 7.2 resulted from two of the five participants selecting a value of 9, one of the five participants selecting a value of 8, and two of the five participants selecting a value of 5 which ultimately resulted in a SD of 2.0. A value of 5 for this particular rating scale is the equivalent of selecting “neutral” for the question. When participants were asked by the experimenter why they chose to select a neutral rating, it was because they had not made any mistakes during their performance tasks. Therefore, researchers can conclude that this question can be interpreted as an overall positive rating.

4.2.3 Participant Comments

All comments made during usability testing were documented. These comments received from participants will be presented and discussed in two sections. The first section will present and discuss comments made during the performance tasks. The second section will present and discuss comments made during the post-task interview.

4.2.3.1 Performance Task Comments

During each of the three tasks performed by each participant, comments were recorded and documented. These comments were then categorized by the experimenter to be either *Satisfactory* or *Unsatisfactory*. The idea behind these categorizations is that during the course of performing a task, a user might make a positive or negative comment due to unknown factors

such as the task difficulty or the good or poor design of the site. For example, if a participant found the task to be very easy, they might make a positive comment such as, “This task is very easy,” which an experimenter could consider a satisfactory comment. If a participant found the task confusing because the application was designed poorly, they might make a negative comment out of frustration such as, “I don’t know how to perform this task.”

Overall, six comments were recorded during the usability testing, and all comments were categorized as *Satisfactory* comments (see table 6).

Table 6. Comments Made During Performance Tasks and their Categorizations

Participant	Comment	Satisfactory	Unsatisfactory
1	Nice graphic split	1	0
1	Good to know so in case you cross state lines or something	1	0
1	The site is not too busy	1	0
3	I like this, because if I am a Service Center leader, I can choose all of the states and prioritize	1	0
4	Wow, I like this	1	0
5	This is pretty user friendly	1	0
Total		6	0

As mentioned previously, one rating scale was presented after each task performed to determine the level of difficulty. If a participant did not select the highest value of 9 on the rating scale (extremely easy), the experimenter followed up with the question, “What could be done to make this task easier to perform?” The resulting comments are shown in table 7.

Table 7. Comments Made During Performance Tasks and their Categorizations

Participant	What can be done to make the task easier?
3	Nothing really, just have to read the names and find the state.
3	As friendly as it can get.
3	No problems.
4	Invert the graph and state choice sections.

4.2.3.2 Post-Task Interview Comments

After all three tasks were performed, a series of questions were posed to participants and comments recorded and documented. The questions posed and the subsequent comments produced are presented below. These comments have been paraphrased for content by VTTI researchers.

- Question 1: Out of the three prioritized lists that you created, which style would you be most likely to use in your job? Let's go back for a moment and re-create that list.
 - Shipper by State (example: Florida)
 - Shipper Service Center Area (example: Eastern Service Center)
 - Shipper for United States

Responses: All five participants responded that the Shipper by State style would be the most likely one used.

- Question 2: Is there another type of prioritized search that you wanted to be able to conduct but were not able to do with this format?

Responses: Two participants indicated that the ability to search for shippers in specific counties might be helpful because they were used to using county codes and county fields when using MCMIS. One participant indicated that a search engine for just typing in the name of a city might be helpful, but also indicated that the procedure used during the usability testing is easy enough. Another participant indicated that being able to distinguish between Pure Shippers and Shipper/Carriers by geographic region might be helpful.

- Question 3: Is the number of companies that we have on this list suitable? If not, how many would you like to appear?

Responses: Two participants indicated that a list containing between 50 to 100 shippers is sufficient. The other three participants indicated that being able to choose the number of shippers to be presented in the results table would be helpful because in some situations they would require more than 100 shippers in the list.

- Question 4: Is the information displayed in this prioritization table what you need prior to going out to inspect? If not, what information is missing that you still need to collect before you can go out to inspect?

Responses: Four of the participants indicated that a column containing shipper DOT numbers would be helpful if there was one available. Two of the participants indicated that a column with the county where the shipper was located would be helpful in the results table. Three of the participants requested that more information be provided on why a shipper has received the priority score presented in the table. Essentially, the participants were looking to investigate further into each shipper at this initial step of prioritization. For example, the participants would be interested in seeing how the priority score was calculated, what were the biggest contributors to the score, how many violations the shipper has, and what type of severity levels are associated with incidents.

- Question 5: Do you think that a help/tutorial page would be useful for this website?

Responses: Four of the participants indicated that a help/tutorial page is not necessary. One participant indicated that it is possible that someone in the field without as much

experience with technology might need some guidance for his or her first time using the site.

- Question 6: Other comments/questions?

Responses: All additional comments and questions are shown below in table 8.

Table 8. Other Comments and Questions Made During the Post-Task Interview

Participant	Comment/Question
1	I wish our other software was like this, it is very intuitive.
1	It would be a nice feature if we could export the table into an excel file.
1	Similar name match capability on existing HMPIPS where shipper name appears but different address or no USDOT#/Differ DOT# is present in HMPIP fields.
2	It can take a day or more to make a prioritization list without this software, so it is helpful.
2	Capability to "Drill Down" to obtain additional details on the individual shipper.
2	The time savings is great.
2	The ability to have more shippers presented in the table would be good, because some states may need more than others.
2	Breaking down each of the algorithm scores would help, because not every problem may be transportation related, so I would like to break it down further.
3	Is there any way to distinguish between Pure Shippers and Shipper/Carriers?
3	Breaking down each algorithm score to show the biggest emphasis would help us when we visit the shipper in order to focus our inspection on a certain area.
3	I believe the Dakotas should be moved to the West service center under the columns.
3	Could I take just the states I want in different service areas?
4	Maybe write the word Sort above each column title or something, so it is more intuitive that clicking will make the table sort by it.
4	Ability to print or save the results table would be nice.
4	Does the score get reset to zero after we have visited them? Or does it just stay the same?
5	Just so you know, the HMPIP does not get checked for accuracy by anyone.
5	Being able to sort by city is good.
5	This is 500 times better than what we have now.
5	Is it possible to export this to an excel file?

4.2.4 Summary of Results

Overall, the results of the usability testing were very positive. The participants used were experienced in the field and were sampled from all four service center areas. All participants successfully completed every task and were able to do so without instruction in a very short period of time. It was concluded that all tasks were rated as very easy to perform. When participants rated the many parameters about HMSPA, all ratings were very high indicating that the design of the beta version of the site was intuitive and easy to use. All comments made during the performance tasks were positive. For example, participants made comments such as, “Wow, I like this,” and “This is pretty user friendly.” During the post-task interview session, many good comments and questions were made by participants. These were both positive comments and feedback on the existing site, as well as many constructive recommendations for future enhancements. In the following section titled, “Modifications Made to HMSPA,” these recommendations will be discussed and the final modifications that were implemented by VTTI will be presented.

4.2.5 Modifications Made to HMSPA

This section will discuss the modifications made to HMSPA after results and feedback were obtained from the usability study. Also covered will be recommendations made during the final peer review meeting made by subject-matter experts.

4.2.5.1 Post Usability Testing Modifications

Although many results and comments obtained during usability testing were good, many HMSPA modifications and improvements were recognized and made prior to delivering the final application to FMCSA. Minor modifications to the site included changing the font and increasing its size on pages where needed. This was done to improve the visibility of the content. Page names were also changed. The name of the “Prioritization” page was changed to “Prioritization Selection” page, and the navigation button name was changed from “Prioritize” to “Selection”. The name of the “Results” page was changed to “Prioritization Results” page. The terms “North Dakota” and “South Dakota” were moved into the appropriate service center column (western) on the Prioritization Selection page. One column was added to the results table. This column included DOT numbers that were available for each specific shipper. Participants also indicated during the usability testing that the ability to choose the number of shippers presented in the results table would be beneficial. In order to meet this request, VTTI made the decision to include all shippers from a selected geographic region in the results table. The final modification made based on usability testing results was including the capability of exporting the results table in to a Microsoft Excel spreadsheet. A button was added to the Prioritization Results page which initiates a dialogue box to choose desired export settings.

4.2.5.2 Post Peer Review Meeting Modifications

The purpose of the final peer review meeting was to review the study findings and conclusions. During this meeting, subject-matter experts were allowed to make recommendations on final

modifications to HMSPA. This section will present any recommendations that differed from recommendations made during the usability testing, and discuss final modifications made.

Similar to comments made by participants in the usability study, the subject-matter experts recommended that the ability to further investigate why a prioritization score was calculated as high as it was would be beneficial. As previously mentioned in Section 3.4, the algorithm contains three main risk measurement scores that are included in the final priority score. These scores are the Enforcement score, the Inspection score, and the Incident score. If these scores were made available in the results table along with the overall priority score, a user might be able to understand problem areas that a shipper may or may not have. With the ability to further investigate the score contributors, a user might be able to better determine appropriate inspection procedures upon arrival at the site. This would in turn create a more efficient inspection process. However, after further review by VTTI researchers, it was deemed that the addition of these columns could also be misused. The algorithm was designed for the purpose of providing a single priority score. Presenting sub-scores that may not be equally comparable could cause users to re-prioritize the list of shippers. Until the algorithm can be further examined specifically for this need, the addition of sub-scores was abandoned. Instead, a new page was added to HMSPA which included detailed information describing the algorithm and how the priority score was calculated.

Experts indicated that a number of territories were not included under the service center names. These members reported that the District of Columbia, Puerto Rico, and the Virgin Islands need to be added to the Eastern Service Center, and Guam, American Samoa, and the Northern Marianas should be added to the appropriate categories. All missing territories were added prior to completing the final application. Experts also had questions regarding who was in charge of maintaining the application and upgrading it over time.

4.3 FINAL HMSPA DESIGN

After all usability testing and peer review meetings were completed, all results and feedback were examined and the final HMSPA was completed. FMCSA personnel will need to integrate and implement the application into the COMPASS system which is the FMCSA-wide IT modernization and business transformation program which stands for, “Creating Opportunities, Methods, and Process to Secure Safety”. FMCSA will also be in charge of maintaining HMSPA upon completion of this project.

The final HMSPA contained four main web pages and are as follows:

- 1) Home Page (figure 11)
- 2) Prioritization Selection Page (figure 12)
- 3) Prioritization Results Page (figure 13)
- 4) About Algorithm Page (figure 14)



Hazardous Materials Shipper Prioritization Application (HMSPA)

[Home](#) [Selection](#) [Results](#) [About Algorithm](#)

HMSPA

Login

Please enter your username and password to access the prioritization tool.

Username:

Password:

If you are having trouble logging into the system, you will need to contact your system administrator.

[Who is my system administrator?](#)

The Hazardous Materials Shipper Prioritization Application (HMSPA) is a tool created to help FMCSA personnel generate a list of hazardous materials shippers that need to be inspected. A unique algorithm has been developed which applies information from four databases in order to prioritize shippers based on certain parameters selected by the user of this tool (e.g. by state, service center area, etc.). The prioritization algorithm obtains information from the following four databases:

HMPPIP - Hazardous Materials Package Inspection Program

MCMIS - Motor Carrier Management Information System

EMIS - Enforcement Management Information System

HMIRS - Hazardous Materials Incident Reporting System

Further information describing the algorithm and how it works is located on the About Algorithm page.

*It is important to note that this application should be used as a tool in combination with other methods for investigating potential HM Shippers in need of inspection and review. Because not all HM Shippers are in the databases, the results table generated by HMSPA will not contain all the HM Shippers that are in a geographical area

Feedback

The accuracy and usefulness of this tool depend on the users. Your feedback allows constant improvements to this tool. Those in the field are the most knowledgeable of the shippers and carriers being inspected. Please offer any comments you feel can better this tool for all.

(C)FMCSA October, 2008

Figure 11. Final HMSPA Home Page



Hazardous Materials Shipper Prioritization Application (HMSPA)

[Home](#) [Selection](#) [Results](#) [About Algorithm](#)

Prioritization Selection



The region you select will prioritize the shippers in that region. Please click on your region of interest on the map above or you can manually select states and territories from the choices below. Each shipper/carrier with a listed address in the selected regions will be added to the prioritization query. Once you have completed selecting the locations of interest, please click the submit button.

West

- Alaska
- American Samoa
- Arizona
- California
- Colorado
- Guam
- Hawaii
- Idaho
- Montana
- Nevada
- New Mexico
- North Dakota
- Northern Marianas
- Oregon
- South Dakota
- Utah
- Washington
- Wyoming

Midwest

- Arkansas
- Illinois
- Indiana
- Kansas
- Iowa
- Minnesota
- Michigan
- Missouri
- Nebraska
- Ohio
- Wisconsin

East

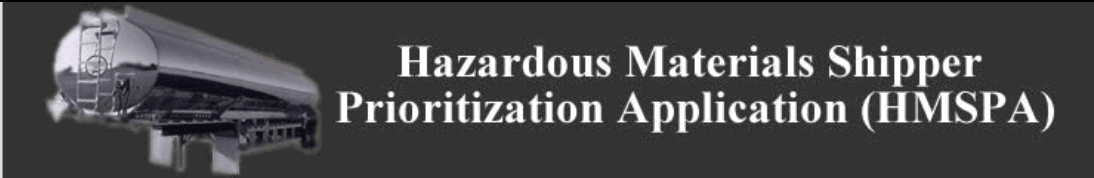
- Connecticut
- Delaware
- District of Columbia
- Maine
- Maryland
- Massachusetts
- New Hampshire
- New Jersey
- New York
- Pennsylvania
- Puerto Rico
- Rhode Island
- Vermont
- Virgin Islands
- Virginia
- West Virginia

South

- Alabama
- Florida
- Georgia
- Kentucky
- Louisiana
- Mississippi
- North Carolina
- Oklahoma
- South Carolina
- Tennessee
- Texas

(C)FMCSA October, 2008

Figure 12. Final HMSPA Prioritization Selection Page



Hazardous Materials Shipper Prioritization Application (HMSPA)

[Home](#) [Selection](#) [Results](#) [About Algorithm](#)

Prioritization Results

Note that the cells shaded RED indicate that multiple company names contributed to that row's priority ranking. View these individual company names by placing your mouse's pointer on the red cell and clicking the right mouse button.


Priority	Company Name	Address	City	State	Zipcode	Phone	US DOT
2				MD	20781		
3				VA	22630		
4				MD	21851		
5				MD	21218		
6				VA	24015		
7				WV			
8				VA	24032		
9				WV	26146		
10				VA	22801		
11				VA	23320		
12				VA	23709		
13				VA	23297		
14				VA	23681		
15				VA	23665		
16				MD	20755		
17				VA	24501		
18				VA	23701		
19				VA	23237		
20				MD	210171229		
21				MD	21222		

Identifying Information
Blurred for Confidentiality

Save As Excel Spreadsheet

(C)FMCSA October, 2008

Figure 13. Final HMSPA Prioritization Results Page



Hazardous Materials Shipper Prioritization Application (HMSPA)

[Home](#) [Selection](#) [Results](#) [About Algorithm](#)

ALGORITHM

The prioritization of shippers utilized an algorithm developed by ABSC Consulting and modified by VTTI. As you recall, the algorithm uses a shipper's past performance as a predictor of risk. There are three distinct categories of shipper performance evaluated: Enforcements, Inspections, and Incidents. Each category was further broken down into several variables: severity, how recent, material involved, and frequency. The overall goal was to use this information specific to a given shipper to determine the likelihood of a violation or incident in the future. Those shippers with the calculated highest risk of future incident were assigned the highest priority, and those with the lowest risk were assigned the lowest priority. Thus, the Prioritization Score (PS) is calculated as the sum of each individual score:

$$\text{Prioritization Score} = ES + I_N S + I_T S$$

Where: *ES* = Enforcement Score

I_NS = Inspection Score

I_TS = Incident Score

The Enforcement Score largely uses the EMIS database, the Inspection Score uses the HMPIP as its data source, and the Incident Score is primarily based on data from the HMIRS. As this algorithm is designed to aid inspectors in utilizing vast amounts of information to more accurately target shippers of greater risk, this score is directly proportional to the risk of a given shipper. As such, the higher the prioritization score, the greater the priority.

ENFORCEMENT SCORE

As stated above there are three main categories of shipper history evaluated. The first is the

Figure 14. Final HMSPA About Algorithm Page (only portion of page shown)

The Home page contained a login area to the left, and a feedback box to the right for users to supply comments and recommendations. The main content of the Home page consisted of a brief description of the site and the databases used for calculating priority scores for shippers. The purpose of the Prioritization Selection page was for a user to choose the geographic area to prioritize shippers by using a map to click service center areas, or by selecting each individual state of interest near the bottom. Finally, an interactive Prioritization Results page was created to display the prioritized list of shippers generated from the Prioritization Selection page. This results table contained 8 different columns of information all of which a user could use to sort. These columns were as follows; Priority, Company Name, Address, City, Zip, Phone, and DOT No. The About Algorithm page contained a detailed discussion on the algorithm.

4.3.1 Technical Development

As previously mentioned in section 3.4, the algorithm is constructed to calculate an overall Prioritization Score (PS). The PS is calculated as the sum of three individual scores: enforcement score, inspection score, and incident score. The algorithm is designed to aid inspectors in utilizing vast amounts of information to more accurately target shippers of greater risk. The prioritization score is converted to a priority number and presented in the Priority column. Therefore, a shipper with higher risk is associated with a higher PS than a shipper with a lower PS number. It is important to note that this application should be used as a tool in combination with other methods for investigating potential HM Shippers in need of inspection. Because HM shippers are not required to register, some HM shippers will not be accounted for in the databases, thus the results table generated by HMSPA will not contain all the HM shippers for a given geographical area. Each individual score will be discussed further in the sections below.

4.3.1.1 Enforcement Score

As stated above there are three main categories of shipper history evaluated. The first is the enforcement history. The Enforcement Score for a given shipper is calculated by multiplying the weighted variables accordingly for a single enforcement action, then summing the scores for all enforcement actions for a given shipper over the same period of time. For a single enforcement action, four weighted variables are taken into account. The four variables are Severity, Time, Multiple Enforcements, and Material.

$$\text{Enforcement Score (ES)} = \sum S_E * W_T * W_{ME} * W_{Ma} \quad \text{Eq. 5}$$

Where:
 S_E = Severity
 W_T = Time Weight
 W_{ME} = Multiple Enforcement Weight
 W_{Ma} = Material Weight

For a more severe enforcement action a higher weight is applied to the severity variable. Similarly, a more recent enforcement action earns a higher numerical weight for the time variable. This variable increases the overall score for shippers who have recently had an infraction, but allows scores to decrease over time if no further infractions occur. The Multiple Enforcements variable accounts for the frequency of infractions for a given shipper. To calculate the Multiple Enforcement variable, each enforcement action is examined individually and then assigned a value equal to the number of enforcements occurring within the six months prior to that action, and the six months after that action. Thus shippers are penalized more for consistently having infractions than shippers that occasionally have an infraction. The final variable, Material, is calculated by a chart assigning weights to each type of HM by class and division. However, VTTI was supplied a spreadsheet containing results of a query against EMIS, rather than an EMIS database export. As such, the material information was not provided and could not be used in the development of this application. Thus, the variable for material weighting was replaced with a constant of 1 for this initial application. It is recommended that the material values specified by ABSC during algorithm development (shown in Appendix I) are utilized when available to increase accuracy of the algorithm. After each variable is defined, the product of all four weights becomes the single enforcement action. After calculating this value

for each enforcement for a given shipper, the total is summed. That sum is applied to the shipper’s Prioritization Score as the final Enforcement Score. Table 9 contains the Enforcement Score variables and the associated locations within the locally housed databases created by VTTI for calculating the algorithm.

Table 9. Enforcement Score Variables and Associated Database Locations

Variable	Database	Table	Columns	Description
U_ID	EMIS	SHIPPERS	NAME, PHY_CITY, PHY_ST	Universal Identification derived as a function of the SoundEx method as described in the Technical Brief.
Severity	EMIS	SEVERITIES_VTTI	EnforcementScore	Severity can be Acute, Critical or Other.
Time Weight	EMIS	ENFORCEMENTS	SHIPPING_DATE	Date associated with violation.
Multiple Enforcement Weight	EMIS	ENFORCEMENTS	SHIPPING_DATE	Date associated with violation.
Material Weight	No data was available	No data was available	No data was available	Hazardous material weight should be based on tabular data from document by ABSC company.

4.3.1.2 Inspection Score

The Inspection Score also consists of four weighted variables: Severity, Time, Multiple Violations, and Material.

$$Inspection\ Score\ (INS) = \sum S_I * W_T * W_{MV} * W_{Ma} \quad Eq. 6$$

Where:
 S_E = Severity
 W_T = Time Weight
 W_{MV} = Multiple Violation Weight
 W_{Ma} = Material Weight

Each citation section in the code is assigned a severity level (provided to VTTI by FMCSA). The weights are directly proportional to the severity, and again a greater severity is assigned a greater weight. The Time variable is calculated in the same manner as it was for the Enforcement Score. A greater value is assigned for a more recent violation, but decreases over time. Again, the multiple violations variable accounts for the frequency of violations. Last, the material weight is defined by the same table used for the Enforcement Score (shown in Appendix I). The product of all four variables becomes the individual violation score. Again, all individual violation scores are summed to provide the Inspection Score for a given shipper. Table 10 contains the Inspection Score variables and the associated locations within the locally housed databases created by VTTI for calculating the algorithm.

Table 10. Inspection Score Variables and Associated Database Locations

Variable	Database	Table	Columns	Description
U_ID	HMPIP	SHIPPERS	SHIPPERS_NAME, SHIPPERS_CITY, SHIPPERS_STATE	Universal Identification derived as a function of the SoundEx method as described in the Technical Brief.
Severity	HMPIP	SEVERITIES_VTTI	InspectionScore	Determined as Level I or Level II based on provided document in report Appendix I.
Time Weight	HMPIP	SHIPMENTS	SHPPING_DATE	Date associated with Inspection.
Multiple Violation Weight	HMPIP	SHIPMENTS	SHPPING_DATE	Date associated with Inspection.
Material Weight	HMPIP	SHIPMENTS	HMCLASS	Hazardous material weight based on tabular data from ABSC document.

4.3.1.3 Incident Score

The incident score is comprised of four weighted variables: Severity, Time, Multiple Incidents, and a variable accounting for Undeclared Shipments.

$$Incident\ Score\ (I_{TS}) = \sum(S_I + US) * W_T * W_{MV} \quad Eq. 7$$

Where:
 S_I = Severity
 US = Undeclared Shipment
 W_T = Time Weight
 W_{MV} = Multiple Violation Weight

The Severity, Time, and Multiple Incident variables are all calculated in the same fashion as previously explained. The severity of an incident can be defined as serious, significant, or minor. The associated weights are 5, 3, and 1 respectively. Due to a lack of citation and severity information, VTTI used a constant severity of 3 for the Incident Score calculations. When citation and severity information from the HMIRS database is available, that information should be used to increase the accuracy of the algorithm scores. Furthermore, the Incident Score accounts for undeclared shipments. This is done by adding a weighted value to the severity variable for an undeclared shipment. There are two types of undeclared shipments, undeclared-no-release or cargo-tank-no-release. As of 2005 this information is noted on Hazardous Materials Incident Report Form 5800.1. Each individual incident score is calculated by summing the severity-variable value with the Undeclared Shipment variable if necessary, and then multiplying that value by the Time variable and Multiple Incident variable. The Incident Score is the sum of all individual incident scores for a given shipper. Table 11 contains the Incident Score variables and the associated locations within the locally housed databases created by VTTI for calculating the algorithm.

Table 11. Incident Score Variables and Associated Database Locations

Variable	Database	Table	Columns	Description
U_ID	HMIRS	SHIPPER	S_NAME, S_CITY, S_STATE	Universal Identification derived as a function of the SoundEx method as described in the Technical Brief.
Severity	No data was available	No data was available	No data was available	Severity should be based on values from ABSC document.
Undeclared Shipment	HMIRS	MATERIAL	UNDECLAR	Box marked on form 5800.1. Also noted in the HMIRS.
Time Weight	HMIRS	IncidentReports	Date of Incident	Date associated with Incident.
Multiple Incident Weight	HMIRS	IncidentReports	Date of Incident	Date associated with Incident.

4.3.1.4 Data Limitations Affecting HMSPA

This report has identified many data limitations that affect the results generated by HMSPA. The first limitation was the lack of Material weights received in the EMIS query. Therefore, all Material weight values were set to a constant of 1 to remove the effect of Material from the algorithm’s calculation. During FMCSA’s implementation of HMSPA, it is recommended that FMCSA use the Material codes from EMIS to determine the Material weight values as specified by ABSC (shown in Appendix I) to increase the algorithm’s accuracy.

The second limitation was the lack of Severity data in the HMIRS database necessary for determining an Incident score; therefore, a constant severity value of 3 was used for all I_TS calculations. It is recommended that this information be populated within HMIRS to increase the algorithm’s accuracy.

FMCSA provided a key that translated each CFR section number to the appropriate severity level which allowed VTTI to develop a data table to be used to determine final severity values. The third limitation involved inconsistent severity levels associated with a particular CFR section number. For instance, CFR section number 172.205(a) is associated with both Severe Level 1 and Severe Level 2 (see Appendix G). The CFR section numbers where discrepancies are present should be addressed so algorithm accuracy is maintained.

The fourth limitation was the lack of consistent shipper identification between databases (i.e., HMPPI, HMIRS, MCMIS, and EMIS). A unique identifier was generated by using a technique called Soundex. Until a primary key for shipper identification can be established across the four databases, the Soundex technique is needed for HMSPA to function. To improve the accuracy of HMSPA, it is recommended that a primary key be established across the four databases.

4.3.2 CSA 2010 Implications

In the SOW, it was stated, "... make the model compliant with the Comprehensive Safety Analysis (CSA) 2010 effort." As defined by FMCSA, the CSA 2010 has the purpose to develop more effective and efficient methods for FMCSA, together with industry and state partners, to achieve its mission of reducing commercial motor vehicle (CMV) crashes, fatalities, and injuries (FMCSA, 2009). Key features include; i) increase the opportunity to have contact with more carriers and drivers, ii) use more and better data to improve performance measurements for identifying high-risk carrier and driver behaviors, and iii) apply a wide range of interventions to correct these high-risk behaviors before they become chronic and habitual. Although this initiative does not specifically target shippers, the model does lend itself to include them. The objective of HMSPA does indeed meet these key features as presented by CSA 2010. This application combines data from multiple data sources and provides a measure with which inspectors can better identify Pure Shippers and Shipper/Carriers that are in need of inspection.

4.3.3 Future Research

While HMSPA is a vast improvement over current prioritization methods used by FMCSA, a key area of research is the continued improvement of HMSPA. As seen in the results of this study, FMCSA field personnel find great value and initial acceptance in HMSPA; however, VTTI would like to propose two areas of research to enhance its functionality. The first area of research would be further refinement of HMSPA algorithm to include risk exposure, differentiating between pure shipper and shipper/carriers, and to adjust the algorithm for use with motor carriers. The second area of needed research is to evaluate the implementation of HMSPA. After HMSPA has been integrated within the FMCSA network, VTTI recommends that a study be conducted to evaluate the performance benefits (i.e., user acceptance over time, system effectiveness in improving the shipment inspection process, and accuracy of the current algorithm) of the application in the field.

5.0 REFERENCES

- Agresti, A. (2002). *Categorical data analysis* (2nd ed.). New York: Wiley-Interscience.
- Bauersfeld, P., (1994). *Software by design: Creating people friendly software*. New York, NY: M&T Books.
- Federal Motor Carrier Safety Administration, (2009). *Comprehensive safety analysis (CSA) 2010*. Retrieved January 25, 2009 from: <http://www.fmcsa.dot.gov/safety-security/csa2010/home.htm>.
- Lait, A.J., and Randell, B. *An assessment of name matching algorithms*. Department of Computing Science, University of Newcastle upon Tyne, September, 1995 (Unpublished).
- Pipeline and Hazardous Materials Safety Administration, (2008). *Office of hazardous materials safety: incident reports database search*. Retrieved August 1, 2008 from: <https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/>.


APPENDIX A: SLIDES PRESENTED AT PEER REVIEW MEETING 1, SCREENING QUESTIONNAIRE, RECRUITMENT E-MAIL TEMPLATE AND INFORMED CONSENT FORM

Slide 1

**Peer Review Committee #1:
Development of Hazardous Materials (HM)
Shipper Prioritization Program**

Team Members:
Andy Schaudt
Darrell Bowman
Stephanie Baker
Andrew Marinik
Blake Stoddard



Sponsored by:
VTRC, FMCSA





Slide 2

Background (i)


- Mid 1990's, an attempt was made to develop a performance-based prioritization for Hazardous Materials (HM) shippers
- Insufficient performance data available
- FMCSA created the HM Package Inspection Program (HMPIP) to focus on inspecting individual shipments at roadside or on carrier docks





Background (ii)

- Package inspection data has grown
 - 1000 package inspections in the year 2001
 - 6000 package inspections in 2006
- A second effort to develop the prioritization
 - In 2003
 - incident data, inspection data, and improved departmental data were now available




2003 Project Accomplishments

- 1) Examined various databases from Federal, State, Industry, and other HM databases to formulate a structure (HMIS, SAFESUM, MDMIS, HMPIP)
- 2) Developed the program and algorithm that would prioritize the shipper after examination of data
- 3) FMCSA started the beta test, however, the analysis has not been completed

VTTI
Driving Transportation with Technology

Purpose of the 2008 project



- Continue the HMPIP development
 - Reviewing
 - Documenting
 - Recommending improvements
 - Fully functioning prioritization application


VTTI
Driving Transportation with Technology

Task I: Kick-off Meeting/Work Plan

- Meet with AOTR; discuss details of project
- A detailed work plan
 - Methods
 - Data reduction
 - Statistical procedures

Today, you will be able to give comments and feedback about our course of action


Slide 7



Task 2: Develop and Execute Peer Review Plan

- Two Peer review meetings
 - At least 3 subject-matter experts involved
 - Conducted via webinar
 - First meeting reviews history, methodology, and data collection
 - Second meeting reviews study findings and conclusions
 - Statement of findings of the overall peer review panel will be completed after each review

Slide 8



Task 3: Review and Examine HM Shipper Prioritization Program (i)

- Review and examine previous work completed during 2003 project
- Develop a plan of approach to fully implement this program within FMCSA

Slide 9

Task 3: Review and Examine HM Shipper Prioritization Program (ii)

- Suggested improvements to algorithm to make HMPIP compliant with the CSA 2010 effort


The diagram illustrates the CSA 2010 Proposed Operational Model (FMCSA, 2007) as a continuous cycle. It starts with 'Motor Carrier Compliance Activities & Crash Reports' leading to 'SAFETY DATA'. This data feeds into 'MEASUREMENT On-Road Safety Performance (OSPC)' which includes Unsafe Driving, Fatigue, Driver Fitness, Drugs and Alcohol, Vehicle Maintenance, Loading/Cargo Securement, and Crash History. The measurement leads to 'SAFETY EVALUATION' (represented by a traffic light icon). From evaluation, three paths emerge: 'Continue to Operate' (green arrow), 'Marginal' (yellow arrow) leading to 'Ongoing Intervention', and 'Unfit' (red arrow) leading to 'UNFIT SUSPENSION'. 'UNFIT SUSPENSION' leads to 'SUSPEND OPERATION'. From 'SUSPEND OPERATION', the cycle returns to 'SAFETY DATA' via 'INTERVENTION' (yellow box) which includes Investigative, Targeted Roadside Inspections, Off-site Investigation, On-site Investigation, Corrective, Warning Letter, Cooperative Safety Plan, Notice of Violation, Notice of Claim, and Consent Agreement. The diagram is captioned 'CSA 2010 Proposed Operational Model (FMCSA , 2007)'.

- Max Effectiveness Resources
- Correct unsafe behavior early
- Assess larger portion of industry
- Reduce large truck-related fatalities

Slide 10


Task 3: Review and Examine HM Shipper Prioritization Program (iii)

- User interviews in regards to the application DESIGN with Field Administrators, Hazmat Program Managers, Division Administrators, and Hazmat Program Specialists (from Peer Review Committee)
 - What are the current methods in place?
 - What are the expectations of this application?
 - What is the end-user's ultimate goals for use of HM Shipper Prioritization Program.



Task 3: Review and Examine HM Shipper Prioritization Program (iv)


- User interviews in regards to the application DEVELOPMENT with Field Administrators, Hazmat Program Managers, Division Administrators, and Hazmat Program Specialists (from Peer Review Committee)
 - What are the current steps taken to establish a prioritization list?
 - Should the interface design be similar to SafeStat?
 - How should it be designed to be simple and intuitive for the end user?



Task 4: Beta Test and Implement HM Shipper Prioritization Program (i)

- Beta test (usability testing) in State(s) with existing program
- Program must take similar format to FMCSA's "Safestat"
- Must be capable to be integrated into the COMPASS system (oracle database)

Slide 13




Driving Transportation with Technology

Task 4: Beta Test and Implement HM Shipper Prioritization Program (ii)

- Five new participants in at least two states
- Correct or enhance features after feedback
- Fully functional HM shipper prioritization program and user manual


Slide 14



Driving Transportation with Technology


Project Timeline

Task #	Task Description	Jan.	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	Months ATA	1	2	3	4	5	6	7	8	9	10	11	12
1a	Kick-off Meeting												
2b	Execute First Peer Review												
2c	Execute Second Peer Review												
3a	Review previous work on HM Shipper Prioritization Program												
3c	Suggested Software Modifications to improve algorithm (CSA 2010)												
4a	Beta test software in State(s) with existing shipper program												
4b	Deliver a fully functional HM Shipper prioritization program												



In Summary

- Peer review committee involvement
- Review and examine HM Shipper Prioritization Program
- Beta test in at least 2 states
- Deliver fully functional application
- Report




Discussion (i)

- Are there any thoughts of possible improvements to the methodology of this project?
- Are there any additional tasks needed for improvement?

The following questions are primary probes. Secondary probes may be used and will depend upon the issues that arise during the discussion. Secondary probes will not stray from the general line of questioning presented here.

Slide 17



Discussion (ii)

- What kind of issues should be discussed in the user interviews that will be crucial for the design and development process?
- You might be contacted in the next few months for possible participation in two user interview phone calls. Is there anyone who would not like to participate?

Slide 18



Thank you for your participation

If you have any questions, please contact:
Andy Schaudt
Phone: 540-231-1591
Email: aschautd@vtti.vt.edu

Subject-Matter Expert Committee Screening Questionnaire (Phone Script)
For the HM Shipper Prioritization Program project

Name of Company _____
Phone Numbers _____
Best Time to Call _____
Screener _____

Note to Researcher:

Initial contact between participants and researchers may take place over the phone. If this is the case, read the following Introductory Statement, followed by the questionnaire. Regardless of how contact is made, this questionnaire must be administered verbally before a decision is made regarding the participant's willingness to participate in this study.

Introductory Statement:

After you call a prospective participant, use the following script as a guideline in the screening interview.

Hello. My name is _____ and I am a researcher at the Virginia Tech Transportation Institute (VTTI) in Blacksburg. I am recruiting volunteers to participate in a peer review committee for a new study funded by the Federal Motor Carrier Safety Administration, specifically volunteers that can provide council during the development of a Hazardous Materials Shipper Prioritization Program focused on inspecting shippers. I obtained your contact information from (choose appropriate identification):

- *James Simmons*
- *Sandra Webb*
- *FMCSA Website*
- _____ *(word of mouth contact)*

May I speak to: (known individual's name)

Note to researcher: If respondent connects researcher to point of contact repeat first section with that person.

If the point of contact is not available:

Could you tell me when a better time would be to contact (known individual's name)?

Better time to call back: _____

If a better time to call back is not given:

Thank you for your time. Goodbye.

PART FOR CONTACT WITH (known individual's name):

Hello. My name is _____ and I am a researcher at the Virginia Tech Transportation Institute (VTTI) in Blacksburg. I am recruiting volunteers to participate in a peer review committee for a new study funded by the Federal Motor Carrier Safety Administration. For this study we need volunteers that can provide council during the development of a Hazardous Materials Shipper Prioritization Program focused on inspecting shippers. I obtained your contact information from (choose appropriate identification):

- *James Simmons*
- *Sandra Webb*
- *FMCSA Website*
- _____ *(word of mouth contact)*

Would it be alright if I asked you a few questions and gave you some information about our study?

If point of contact does not want to continue:

Thank you for your time. Goodbye.

If point of contact agrees to continue:

Great! Let me tell you more about our study.

The purpose of this project is to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program. The result of this study will be the implementation of a fully functioning web-based application for generating priority lists of shippers to be inspected.

The Shipper Prioritization Program has been under development at the Federal Motor Carrier Safety Administration (FMCSA) since the early 1990s. FMCSA continued to address this issue all the way until 2003 and was able to advance the project to the beta testing phase; however, contractual and financial issues arose and the project was abandoned.

If you choose to participate, you will be part of a Subject-Matter Expert Committee. This committee will meet in a Webinar and/or teleconference to discuss the project plan before it proceeds, and also meet in a second Webinar and/or teleconference to discuss the results of the project. A webinar is an internet-based web conferencing application that allows remote users to log in to an internet site and view presentations, conduct meetings and discussions, share applications, and post feedback. As a member of this committee, we are hoping you can provide feedback on the prioritization process that you may have experienced, any methods currently in use, and feedback on our plan of action. You will also have the option of participating in some user interviews during the design and development process of this application. Unfortunately we cannot pay you for your participation as this is a project sponsored by FMCSA and you are an employee of FMCSA. However, the benefit to you will be having direct input into the HM Shipper Prioritization Program which you will most likely use in the future.

Each meeting will last no longer than one hour. During this time you will be asked questions and you will have the opportunity to share your thoughts and opinions.

Do you have any questions about this project?

Would this be something that you would be interested in participating in?

If they indicate that they are not interested: *Thank you for your time.*

If they indicated that they are interested:

That's great. First of all, I would like to ask you some questions.

If they remain interested, move to the following questions.

Questions

1. *I'd just like to confirm that the name we have for you is correct (Read name and update if necessary)*

Committee Member Name: _____

2. *I'd also like to make sure that I have the correct spelling for your name. I have (read and update):*

First: _____ *Last:* _____

Now I would like to ask you a few questions regarding the responsibilities of your position within FMCSA as well as equipment availability for the meetings.

1) *What is your title @ FMCSA?*

2) *What would you say are your primary responsibilities?*

3) *Do you help coordinate the effort in the inspections of HM Shippers and/or carriers?*

4) *Do you have a computer available with a high-speed internet connection? If yes, what operating system is it running?*

5) *We have two ways that you can participate in the Peer Review Committee Meeting, you can log-in to a website that we will set up and call in with your phone and take part through a Webinar or you can just call in and take part by teleconference. Which way would you prefer to participate?*

6) *Do you have any questions?*

Wonderful! Thank you for taking the time to answer all of my questions. I do have a few logistics to go over with you now.

If you choose to participate, we will be scheduling our first Peer Review Meeting Webinar and teleconference in late April. Our dates aren't set quite yet, however would there be a time frame that would be best for you?

Time frame given: _____

May I have a phone number where _____ you can be reached and the hours/days when it's best to call _____ ?

Name _____

Phone Numbers: (____) _____ Home Work Cell

 (____) _____ Home Work Cell

Best time to call: Any Mornings Afternoons Nighttime Weekends

Other: _____

A researcher will be calling you very soon to discuss the details of the meeting and to answer any questions you may have. If you have any questions in the mean time or need to contact us for any reason please call Andy Schaudt at 540-231-1591 and he will help you with anything you need.

Thank you so much for your time and we look forward to speaking to you again very soon. Have a nice day!

If at any point in the screening they indicate that they are **no longer** interested tell them:
Thank you for your time.

Subject-Matter Expert Committee Verification Email

[Date]

[Potential Committee Member Name Here]
[Potential Committee Member Position/Title]
Federal Motor Carrier Safety Administration (FMCSA)
1200 New Jersey Avenue SE
Washington, DC 20590

Dear [Name Here]:

My name is Andy Schaudt and I am a Research Associate at the Virginia Tech Transportation Institute (VTTI) in Blacksburg. I am recruiting volunteers to participate in a peer review committee for a new study funded by the Federal Motor Carrier Safety Administration, specifically volunteers that can provide council during the development of a Hazardous Materials Shipper Prioritization Program focused on inspecting shippers. You were recommended to us as a possible participant by James Simmons and Sandra Webb from the Hazardous Materials Division of FMCSA.

The purpose of this project is to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program. The result of this study will be the implementation of a fully functioning web-based application for generating priority lists of shippers to be inspected. If you choose to participate, you will be part of a Subject-Matter Expert Committee. This committee will meet in a Webinar and/or teleconference to discuss the project plan before it proceeds, and also meet in a second Webinar and/or teleconference to discuss the results of the project. As a member of this committee, we are hoping you can provide feedback on the prioritization process that you have experienced, current methods in use, and feedback on our plan of action. However, the benefit to you will be having direct input into the HM Shipper Prioritization Program which you will most likely use in the future.

This email was sent to you so that we could verify your correct contact information, specifically your phone number so that we can call you to ask a few questions about participation in the committee. Could you please provide us with your contact information as well as a convenient time for us to call and discuss the project for approximately 5 minutes?

Thank you, in advance, for your consideration of our request.

Sincerely,

Andy Schaudt, M.S.

Research Associate, Advanced Systems & Applications
Center for Truck and Bus Safety, VTTI
3500 Transportation Research Plaza
Blacksburg, VA 24061
Office: 540.231.1591
aschaudt@vtti.vt.edu

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants of Investigative Projects

Title of Project: Subject-matter Expert Committee Peer Review for the Development of Hazardous Materials (HM) Shipper Prioritization Program (Expert Committee)

Investigators: Darrell Bowman, Andy Schaudt, Stephanie Baker, Andrew Marinik, & Blake Stoddard

I. THE PURPOSE OF THIS RESEARCH PROJECT

The Shipper Prioritization Program has been under development at the Federal Motor Carrier Safety Administration (FMCSA) since the early 1990s. Traditionally, FMCSA's shipper program has been driven by complaints. In the mid 1990s, an attempt was made to develop a performance-based prioritization for Hazardous Materials (HM) shippers, similar to a program called SafeStat for HM carriers, but at that point there was insufficient performance data to develop such a system. In response, FMCSA developed the HM Package Inspection Program (HMPIP) to focus on inspecting individual shipments of HM at the roadside or on carrier's docks. Based on package inspection data collected during HMPIP inspections, HM incident data, and improved departmental data identifying companies involved in shipping HM, FMCSA has begun a second effort to develop a performance-based prioritization of HM shippers.

The Virginia Tech Transportation Institute has been contracted to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program. This project is intended to help FMCSA successfully implement its HM Shipper Prioritization Program. The purpose of the peer review process of this project is to form a committee which can advise VTTI about the project design, the HM Shipper Prioritization Program application development and implementation.

II. PROCEDURES

You will be taking part in two subject-matter expert committee meetings in 2008. The purpose of the first committee meeting is for Virginia Tech Transportation Institute (VTTI) to provide the committee members with background information on the project as well as have the study methodology and data collection techniques reviewed by the committee. This information will be provided to the committee via a PowerPoint presentation. The meeting will be conducted as a webinar. (A webinar is an internet-based web conferencing application that allows remote users to log in to an internet site and view presentations, conduct meetings and discussions, share applications, and post feedback.) This conferencing method is efficient and practical for sharing ideas and soliciting feedback. The purpose of the second Committee meeting is to review the study findings and conclusions. This second meeting will follow similar procedures as described in the first committee meeting. Each meeting will last no longer than one hour. During this time you will be asked questions and you will have the opportunity to share your thoughts and opinions. These meetings will be audio recorded. Three to five subject-matter experts will be in attendance as well as two facilitators from VTTI.

III. RISKS

There are no more than minimal risks involved with participation in this study. These risks include possible minor discomfort at sharing your opinions with others during a webinar or teleconference. However, you are free to end your participation at any time if you become uncomfortable.

IV. BENEFITS

No promise or guarantee of benefits will be made to encourage your participation. You may find the focus group discussion to be interesting and your participation may impact the development of the HM Shipper Prioritization Program.

V. EXTENT OF ANONYMITY AND CONFIDENTIALITY

The verbal responses you make during these meetings will be kept strictly confidential. Your name will not be associated with any comments that you make. Audiotapes used during this focus group will be transcribed and then erased. Data collected will be stored at the Virginia Tech Transportation Institute and access to the data will be under the supervision of Darrell Bowman, Andy Schaudt, Stephanie Baker, Andrew Marinik, and Blake Stoddard. It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. COMPENSATION

Your participation will be completely voluntary. No compensation will be provided.

VII. FREEDOM TO WITHDRAW

As a voluntary participant, you may withdraw at any time for any reason without penalty.

VIII. APPROVAL OF RESEARCH

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University.

IX. PARTICIPANT'S RESPONSIBILITIES

I voluntarily agree to participate in this study. I understand that I have the following responsibilities:

1. Listen to all of the committee leader's instructions.
2. Provide responses, as you are able, to the committee leader's questions.
3. Respect the opinions of others.

XI. PARTICIPANT'S PERMISSION

I have read and understand the requirements, procedures, and conditions of these subject-matter expert committee meetings. I have had all of my questions answered. I hereby acknowledge that by logging in /calling in to the Webinar/teleconference that I am providing my voluntary consent to take part in this study.

If I participate in this study, I understand that I may withdraw at any time without penalty and that I may refuse to answer any questions. I agree to abide by the rules of this project.

Should I have any questions about this research or its conduct, I may contact:


Darrell Bowman @ (540) 231-1068, or by email: dbowman@vtti.vt.edu

Andy Schaudt @ (540) 231-1591, or by email: aschaudt@vtti.vt.edu

If I should have any questions about the protection of human research participants regarding this study, I may contact Dr. David Moore, Chair of the Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email: moored@vt.edu; address: Research Compliance Office, 1880 Pratt Drive, Suite 2006 (0497), Blacksburg, VA 24061.

APPENDIX B: SLIDES PRESENTED AT PEER REVIEW MEETING 2

Slide 1




**Peer Review Committee #2:
Development of Hazardous Materials (HM)
Shipper Prioritization Program**

Team Members:
Andy Schaudt
Darrell Bowman
Stephanie Baker
Andrew Marinik


Sponsored by:
VTRC, FMCSA

Slide 2




Overview

- Quick Background of Project
- Website Screen Shots
- Beta Testing Methodology
- Results
- Summary
- Discussion




VTPI
Driving Transportation with Technology

Purpose of the 2008 project



- Continue the HMPIP development
 - Reviewing
 - Documenting
 - Recommending improvements
 - Develop fully functioning prioritization application
 - Beta Test application
 - Deliver to FMCSA



**Hazardous Materials Shipper
Prioritization Application (HMSPA)**

HMSPA

Login

Please enter your username and password to access the prioritization tool.

Username:

Password:

If you are having trouble logging into the system, you will need to contact your system administrator.

[Who is my system administrator?](#)

Feedback

The accuracy and usefulness of this tool depend on the users. Your feedback allows constant improvements to this tool. Those in the field are the most knowledgeable of the shippers and carriers being inspected. Please offer any comments you feel can better this tool for all.

What are your thoughts regarding this web screen shot? Questions?

Website Screen Shot #1

Slide 5

Hazardous Materials Shipper Prioritization Application (HMSPA)

Home | **Prioritize** | Results | About Algorithm

Region

The region you select will prioritize the shippers in that region. Please click on your region of interest below:

You can also manually select states and territories. Each shipper/carrier with a listed address in the selected regions will be added to the prioritization query. Once you have completed selecting the locations of interest, please click the submit button.

West	Midwest	East	South
<input type="checkbox"/> Alaska	<input type="checkbox"/> Arkansas	<input type="checkbox"/> Connecticut	<input type="checkbox"/> Alabama
<input type="checkbox"/> Arizona	<input type="checkbox"/> Illinois	<input type="checkbox"/> Delaware	<input type="checkbox"/> Florida
<input type="checkbox"/> California	<input type="checkbox"/> Indiana	<input type="checkbox"/> Maine	<input type="checkbox"/> Georgia
<input type="checkbox"/> Colorado	<input type="checkbox"/> Kansas	<input type="checkbox"/> Maryland	<input type="checkbox"/> Kentucky
<input type="checkbox"/> Hawaii	<input type="checkbox"/> Iowa	<input type="checkbox"/> Massachusetts	<input type="checkbox"/> Louisiana
<input type="checkbox"/> Idaho	<input type="checkbox"/> Minnesota	<input type="checkbox"/> New Hampshire	<input type="checkbox"/> Mississippi
<input type="checkbox"/> Montana	<input type="checkbox"/> Michigan	<input type="checkbox"/> New Jersey	<input type="checkbox"/> North Carolina
<input type="checkbox"/> Nevada	<input type="checkbox"/> Missouri	<input type="checkbox"/> New York	<input type="checkbox"/> Oklahoma
<input type="checkbox"/> New Mexico	<input type="checkbox"/> Nebraska	<input type="checkbox"/> Pennsylvania	<input type="checkbox"/> South Carolina
<input type="checkbox"/> Oregon	<input type="checkbox"/> North Dakota	<input type="checkbox"/> Rhode Island	<input type="checkbox"/> Tennessee
<input type="checkbox"/> Utah	<input type="checkbox"/> Ohio	<input type="checkbox"/> Vermont	<input type="checkbox"/> Texas
<input type="checkbox"/> Washington	<input type="checkbox"/> South Dakota	<input type="checkbox"/> Virginia	
<input type="checkbox"/> Wyoming	<input type="checkbox"/> Wisconsin	<input type="checkbox"/> West Virginia	

Website Screen Shot #2

What are your thoughts regarding this web screen shot? Questions?

Slide 6

Hazardous Materials Shipper Prioritization Application (HMSPA)

Home | Prioritize | **Results** | About Algorithm


Shippers

Priori	Company Name	Address	City	State	Zipcode	Phone
1,440			TAMPA	FL		
792			WEST PALM	FL	33413	
504			BUNNELL	FL	32110	
252			MIRAMAR	FL	33025	
252			TALLAHASSEE	FL	32310	
216			ODESSA	FL	33556	
216			ODESSA	FL	33556	
210			JACKSONVILLE	FL	32216-8013	
192			MIAMI	FL	33178	
180			DEERFIELD	FL	33442	
144			ORLANDO	FL	32824	
144			POMPANO	FL	33064	
144			RIVERA BEACH	FL	33404	
120			MIAMI	FL		
120			MULBERRY	FL	33860-1100	
80			MIAMI LAKES	FL	33014	
72			MEMPHIS	FL	38126	
60			DORAL	FL	33122	
60			ATLANTIC	FL	32233	
60			MIAMI	FL	33166	

(C)FMCSA October, 2008


Website Screen Shot #3

What are your thoughts regarding this web screen shot? Questions?



Beta Testing

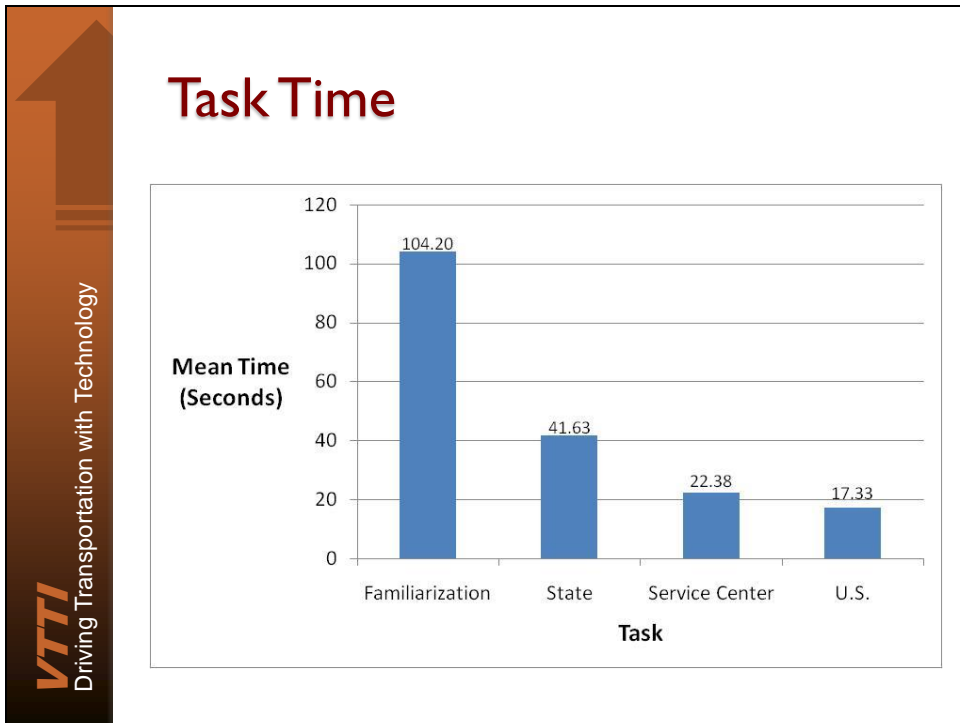
- Beta Testing (Usability Testing) was performed in 5 different states with 5 participants (all of which were recommended by you)
- Each user performed some basic prioritization tasks with the site
- Data was collected and analyzed (both subjective and objective)



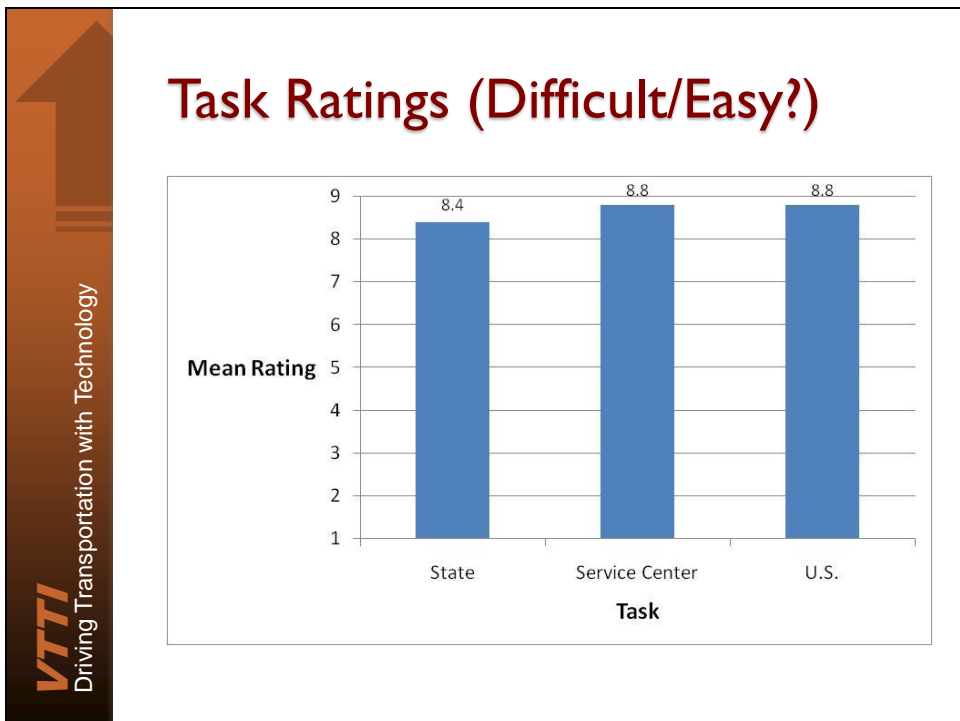
Results

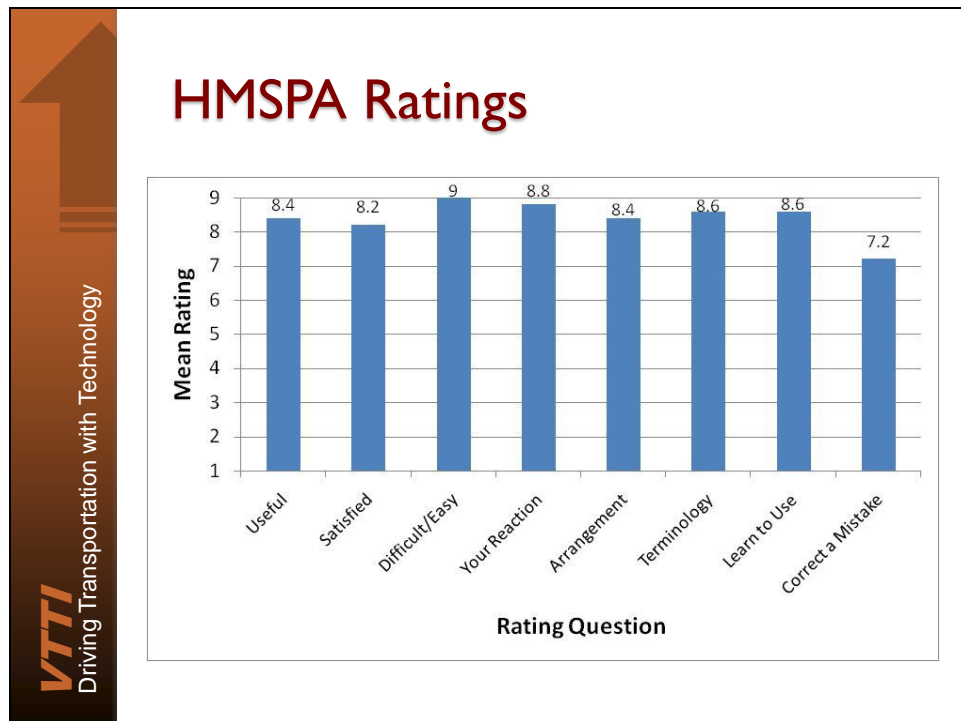
- Descriptives
 - 5 participants, each in a different state
 - All 4 service centers sampled
 - Average experience = 12 years
 - On average, the entire usability session lasted 38 minutes
 - Participants performed tasks on HMSPA, all tasks were successfully completed

Slide 9



Slide 10






Conclusions


- Overall results were very good
- Additional columns to be added to the results table
- Further tasks:
 - *Additional interface changes (minor)*
 - *Technical Brief; User Manual; Training session*
 - *Final Documentation*

What are your thoughts regarding the results? Questions?



In Summary

- Peer review committee involvement
- Review and examine HM Shipper Prioritization Program
- Beta test in at least 2 states
- Deliver fully functional application
- Report



Discussion

- What is your overall impression of how this entire project was executed?
- Do you feel your comments and suggestions (participation) in this committee were adequately used in this project?
 - If not, why not?
- Do you have any suggestions for improvements to the HM Shipper Prioritization Application?



VTTI
Driving Transportation with Technology

Thank you for your participation

If you have any questions, please contact:
Andy Schaudt
Phone: 540-231-1591
Email: aschaudt@vtti.vt.edu

APPENDIX C: DOCUMENTATION OF ALGORITHM 1

A RISK-BASED ALGORITHM FOR PRIORITIZING HAZARDOUS MATERIAL SHIPPER AUDITS

James O. Simmons
U.S. Department of Transportation
Federal Motor Carrier Safety Administration
Hazardous Materials Division
Washington, DC USA

William R. Rhyne
Thomas A. Taylor
ABSG Consulting Inc.
Knoxville, TN USA

Summary/Abstract: The Federal Motor Carrier Safety Administration (FMCSA) audits both shippers and carriers of hazardous materials (HM), but resources are limited. One method of reducing risks is to minimize the occurrences of serious HM incidents, and strategies to achieve this goal include targeted enforcement of the HM regulations. The HM shipper prioritization program is one way that FMCSA can manage its resources more efficiently and effectively to focus on shippers with performance problems and on the HM posing the greatest risks. The HM shipper prioritization program seeks to answer the question: Which HM shippers present the highest risk? A prioritization algorithm is being developed based on measures of HM transportation risk that can be quantified using current U.S. Department of Transportation (DOT) databases. These risk measures are: (1) the number and severity of HM enforcement actions, (2) the number and severity of HM inspection violations, and (3) the number and severity of HM incidents. Severity is defined by either FMCSA or Pipeline and Hazardous Materials Safety Administration (PHMSA) procedures. Weighting factors are used to emphasize more recent occurrences, multiple occurrences in a short time frame, and the more hazardous materials.

RISK MEASURES

Risk is the combination of the frequency of a potential release and the consequence of a potential release. A high number of shipments, particularly of high hazard materials, implies a high risk, and a high number of enforcement actions, inspection violations, or incidents also implies a high risk. Stated more formally, the transportation risk for a specific HM shipper location is proportional to (1) the number of shipments of each type of HM from that location, (2) the probability of a release of each type of HM, and (3) the hazard posed by each type of HM. The first two parameters are measures of the frequency component and the third is a measure of the consequence component.

The FMCSA and other modal administrations conduct inspections and initiate enforcement actions. In addition, HM incidents are reported to the PHMSA. The number and severity of enforcement actions, inspection violations, and incidents are indicators of the risk associated with an individual shipper.

DATA AVAILABILITY

Transportation risk quantification is only as good as the data used, which can be only as good as the data available. The number and severity of enforcement actions, inspection violations, and incidents are among the data available to the FMCSA through the Intermodal Hazardous Material Data Management Service.

Intermodal Hazardous Material Data Management Service (HazDB)

HazDB began in 2003 under the sponsorship of the Federal Aviation Administration (FAA) and is now maintained by the PHMSA. HazDB is a compilation of data from a number of DOT databases, and those databases relevant to shipper prioritization are described next.

Hazardous Materials Package Inspection Program (HMPIP)

HMPIP allows rapid collection of HM package details and the recording of violations discovered during FMCSA dock checks and vehicle roadside inspections. HM packaging violations can be recorded on a laptop and uploaded during/after an inspection. Package, shipper, and other data can be downloaded from the central database.

Hazardous Materials Incident Reporting System (HMIRS)

HM incidents during transport by highway, rail, air, and water modes are required to be reported to the PHMSA. A large amount of the HMIRS data describes cause, consequence, and geographic location characteristics of a HM release. In addition, there is a large amount of data on the packaging and how it was damaged. HMIRS data used by the Shipper Prioritization Program is limited to the shipper information, incident date, and data needed to categorize the incident severity. All incidents are linked to a shipper responsibility because there is no parameter to indicate shipper or carrier responsibility. An isolated incident incorrectly attributed to a shipper is not a significant contributor to a shipper's prioritization score owing to the weighting factors used as described below.

Hazardous Materials Registration

Some, but not all, HM shippers and carriers are required to register annually with the PHMSA. Intermediaries such as freight forwarders must register if they perform the functions of an offeror, and if so, they would be of interest to the HM Shipper Prioritization Program. A shipper or carrier must register if it offers or transports:

- A. Large quantities of a Class 7 (radioactive) material.

- B. Certain quantities of a Division 1.1, 1.2, or 1.3 (explosive) material.
- C. Certain quantities of poisonous gas.
- D. A hazardous material in a large bulk packaging.
- E. A large non-bulk shipment for which placarding is required for that class.
- F. Most quantities of hazardous material that require placarding.

The registration database is used to populate a master shippers list, but a limitation is that only the principal place of business is registered, rather than all of the company's HM shipping locations.

Unified Shippers Enforcement Data System (UNISHIP)

UNISHIP is a cross-modal system maintained by PHMSA that contains data on closed enforcement actions for Federal Highway Administration (FHWA), FMCSA, Federal Railroad Administration (FRA), PHMSA, and U.S. Coast Guard (USCG). The system allows enforcement personnel to determine if past violations of the HM regulations have been pursued by any DOT administration. UNISHIP does not include data for the identification of the HM; this is a significant omission for shipper prioritization.

Airport/Air Carrier Information Reporting System (AAIRS) and Enforcement Information System (EIS)

AAIRS is used by the FAA to track inspections of airports and air carrier stations. It includes both discrepancies found and HM incidents (which are also reported to HMIRS). The EIS is used by the FAA to track enforcement actions for violations found through inspections or through other means (e.g., police reports). The lack of data for the identification of the HM is a significant omission for shipper prioritization.

Railroad Inspection Reporting System (RIRS)

The FRA conducts inspections of track, signal and train control; rolling equipment; operations; and all aspects of compliance with the HM regulations. Data on the railroad inspected and the violation are among those in RIRS; however, the shipper is not identified.

Other Databases

The Transportation Security Administration (TSA) is compiling a database of known shippers. The FAA originated this database in response to safety concerns over air cargo shipments, and the original data are in HazDB. TSA has not yet released that data to us; when it is received, it will be incorporated.

The FMCSA maintains the Motor Carrier Management Information System (MCMIS) that is organized into five information areas: census (name, address, etc), inspection, crash, compliance reviews, and enforcement. The database is focused on carriers rather than shippers, and our current approach is to obtain shipper data from the source uploading into MCMIS.

Other federal databases, such as the Commodity Flow Survey, do not have the level of detail needed to prioritize individual shippers. Commercial databases are not currently utilized in the HM Shipper Prioritization Program.

Limited Internet searches were made based on organization membership lists and conference advertisers to locate chemical shipper street addresses. Emphasis was placed on locating HM shippers that might not be required to register with PHMSA. Many companies were found that clearly are HM shippers, but street addresses were not on their Web site, possibly due to deletions after 9/11.

CALCULATION OF THE RISK MEASURES

The risk measures for shipper prioritization that can be quantified with data currently available to FMCSA are (1) the number and severity of enforcement actions, (2) the number and severity of inspection violations, and (3) the number and severity of incidents. The shipper priority is the sum of scores using these three types of data:

$$\text{Shipper Priority Score} = \text{Enforcement Score} + \text{Inspection Score} + \text{Incident Score}$$

Enforcement Score

FMCSA and the other DOT operating mode administrations may initiate enforcement action, and an enforcement score can be defined as:

$$\text{Enforcement Score} = \sum \text{Enforcement Severity} \times \text{Time Weighting} \times \text{Multiple Enforcement Weighting} \times \text{Material Weighting}$$

where the sum is over all enforcements for a shipper. Values for the weighting parameters in this and the other scores are selected to emphasize aspects of HM transportation based on the regulatory experience of the FMCSA field staff. Each of these parameters is described next.

The dollar penalty collected is reported; however, since the penalty amount for the same enforcement action may vary across the administrations, the enforcement severity is based on the regulation section cited. The FMCSA severity categories are used for shipper prioritization. The most severe violation, an acute violation, is assigned a severity value of 20. The next most severe violation, a critical violation, is assigned a severity value of 12. All other violations are assigned a severity value of 4.

Enforcement actions that closed recently will be weighted more heavily than those that closed in the more distant past. Time data fields in the various databases may include only the year or both the year and the month. If the time data field includes the month,

then any enforcement action in the most recent 12 months will be weighted by a value of 6, weighted by a value of 3 for the next most recent 12 months, weighted by a value of 1 for the next most recent 12 months, and weighted by a value of 0 (i.e., not used) for previous months. If the time data field includes only the year, the procedure used to determine the weighting value is adjusted accordingly.

Multiple enforcement actions within a short time frame are weighted more heavily. A weighting of n is used for enforcements of any severity level in the same 12-month time span where n is the number of enforcements of any severity level in the 12-month time span centered on the enforcement date. For example, each enforcement action (called the original in this example) is checked to see how many other enforcement actions occurred in the six months before (choose two for the example) and in the next six months (choose one for the example). Counting the original enforcement action, the total is four, and the original enforcement action would be weighted by a value of four. The multiple-enforcement weighting procedure is similar to the time-weighting procedure, except that it is more complex to adjust for the case that the next 6-month time span projects beyond the present.

Material weighting reflects the relative hazard of the material; however, some of the databases do not contain data on the HM involved. If HM data are available, the material weighting factor values shown in Table 1 are used. (The table is based on 49 CFR 173.2(a) as modified by FMCSA staff for shipper prioritization.) If HM data are not available, a material weighting factor value of 4 is chosen as a value that is expected to be neutral (i.e., neither over-weight nor under-weight the material hazard for the enforcement score relative to the inspection score, which is addressed next). As the databases become populated, this weighting factor value can be refined to assure its neutrality.

Inspection Score

FMCSA and the other DOT operating mode administrations inspect HM shipments, and an inspection score can be defined as:

$$\text{Inspection Score} = \sum \text{Inspection Violation Severity} \times \text{Time Weighting} \times \\ \text{Multiple Violation Weighting} \times \\ \text{Material Weighting}$$

where the sum is over all inspections for a shipper. Each of the parameters is described next.

The most severe inspection violation, an acute violation, is defined the same as cited above for enforcement actions and is assigned a severity value of 10. The next most severe inspection violation, a critical violation, is defined the same as cited above for enforcement actions and is assigned a severity value of 6. All other inspection violations are assigned a severity value of 2. (These inspection severity weighting values are half

those of the enforcement severity weighting values and twice those the incident severity values discussed next.)

The material weighting, time weighting and multiple-violation weighting procedures are the same as that described for enforcement actions.

Table 1. Material Weighting Factors

Class and Division	Weighting Factor
1.1 Explosives – mass detonating 1.2 Explosives – projectile hazard 1.3 Explosives – fire hazard 2.1 Flammable gases 2.3 Toxic gases 6.1 Toxic substances – Zones A & B 7 Radioactive (HRCQ*)	10
1.5 Explosives – insensitive mass detonating 4.3 Water reactive materials 5.1 Oxidizing substances 5.2 Organic peroxides 6.1 Toxic substances – Except Zones A & B	5
1.4 Explosives – no significant blast hazard 2.2 Non-flammable gases 3 Flammable/combustible liquids 4.1 Flammable solids 4.2 Spontaneously combustible material 7 Radioactive materials (except HRCQ*)	2
1.6 Explosives – extremely insensitive 6.2 Infectious substances 8 Corrosive substances 9 Miscellaneous materials	1

Highway Route Controlled Quantity

Incident Score

The incident score is based on HMIRS data, and an incident score can be defined as:

$$\text{Incident Score} = \sum (\text{Incident Severity} + \text{Undeclared Shipment Severity}) \times \text{Time Weighting} \times \text{Multiple Incident Weighting}$$

where the sum is over all incidents and undeclared shipments for a shipper. Each of the parameters is described next.

The incident severity value is based on the PHMSA incident definitions of serious, significant, or minor with values of 5, 3, and 1, respectively. (These incident severity values are half of the inspection severity values.)

Effective January 2005, two new reportable incidents are defined that do not involve a release of HM: (1) an undeclared shipment with no release and (2) a specification cargo tank of 1,000 gallons or greater, containing any HM that (a) received structural damage to the lading retention system or damage that requires repair to a system intended to protect the lading retention system and (b) did not have a release. We will refer to the former as undeclared-no-release and the latter as cargo-tank-no-release. Prior to January 1, 2005, the information that a shipment was undeclared might be provided in the comment field of the form for an incident reportable for other reasons and subsequently coded in one of two miscellaneous data fields.

An incident that is categorized as either serious, significant, minor, or cargo-tank-no-release can also be an undeclared shipment. If an undeclared shipment is involved, a severity value of 3 is added to the incident severity score. This value was chosen to make an undeclared shipment of equal importance to a significant incident. Table 2 shows the combinations of incident categories with and without an undeclared shipment and the combined incident severity weighting factor values. For purposes of shipper prioritization, cargo-tank-no-release is ignored unless an undeclared shipment also is found.

The time-weighting procedure is the same as that described for enforcement actions. The multiple-incident weighting procedure is the same as that described for enforcement actions with the exception that only significant and serious incidents, as well as undeclared shipments, are considered. Minor incidents are not included because that would over-prioritize shippers who are diligent in reporting all minor incidents.

STATUS OF THE PROGRAM

An objective is to prioritize HM shippers the way that a risk-informed, senior inspector would if he had access to the data and sufficient time to analyze the data. To this end, a Web site was created earlier this year for alpha testing by the FMCSA field staff to select weighting factors that would emphasize those HM shipments that, in their experience, warranted the most attention. A beta testing version based on the alpha version feedback was placed on the Web site in September to obtain experience with the algorithm and to obtain additional feedback.

Table 2. Incident Severity Weighting Factor Values

Incident Category	Undeclared Shipment Involved?	Combined Incident and Undeclared Shipment Severity Value
Serious	Yes	8
	No	5
Significant	Yes	6
	No	3
Minor	Yes	4
	No	1
Cargo-Tank-No-Release	Yes	3
	No	0
Undeclared-No-Release	Yes (by definition)	3

APPENDIX D: DOCUMENTATION OF ALGORITHM 2



January 5, 2005

BUSINESS CONFIDENTIAL

Mr. William Quade, Chief
Hazardous Materials Division
Federal Motor Carrier Safety Administration
400 Seventh Street, SW
Washington, DC 20590

HAZARDOUS MATERIALS SHIPPER PRIORITIZATION PROGRAM: LR-110R4.03-01
DESCRIPTION OF THE ALPHA TESTING ALGORITHM (GEMS 1232932)

The Hazardous Materials Shipper Prioritization Program that ABSG Consulting Inc. (ABS Consulting) is developing for the Federal Motor Carrier Safety Administration (FMCSA) is ready for alpha testing. ABS Consulting has created four test versions with different combinations of the values for the incident and enforcement weighting factors. The algorithm is described in this letter report.

It is hoped that additional data on the annual number and type of shipments will become available from shippers in cooperation with industry organizations such as the American Chemistry Council. Details of the data sought are described in Attachment 1 to this letter report. In some places in the main text, italicized words are used to show where such additional data would be used.

ALGORITHM

Risk is the combination of the frequency of a potential release and the consequence of a potential release. The prioritization algorithm will be based on measures of transportation risk:

$$\text{Shipper Priority} = \sum \text{Transportation Risk Measures.}$$

These measures will be based on three types of input data: (1) incidents, (2) enforcement actions, and (3) *shipments*. The numbers of incidents, enforcements, and *shipments* are measures of the frequency component of risk. The Research and Special Programs Administration (RSPA) category of the incident severity, the violation level for the enforcement action, and the *hazard level of the shipment* are measures of the consequence component of risk. The shipper priority then becomes a weighted sum of these three types of data:

$$\text{Shipper Priority} = (\text{Incident Score} \times \text{Incident Weighting}) + \\ (\text{Enforcement Score} \times \text{Enforcement Weighting}) + \\ (\text{Shipment Score} \times \text{Shipment Weighting}).$$

BUSINESS CONFIDENTIAL

Mr. William Quade, Chief
HAZARDOUS MATERIALS SHIPPER PRIORITIZATION PROGRAM:
DESCRIPTION OF THE ALPHA TESTING ALGORITHM (GEMS 1232932)

Page 2
LR-110R4.03-01

Incident Score

The incident score is based on the data from Form 5800.1:

$$\text{Incident Score} = \sum ((\text{Incident Severity} + \text{Undeclared Shipment}) \times \text{Time Weighting} \times \text{Multiple Incident Weighting} \times \text{Normalization Weighting})$$

The sum is over all incidents with a non-zero time weighting value. An incident in a nontruck (e.g., air) mode is of interest if the shipper is a highway shipper as well. The incident severity value will be based on the RSPA incident definitions of serious, significant, or neither; values of 5, 3, and 1, respectively, are used in three versions for the alpha test. A fourth version uses 50, 10, and 1. The amount of material spilled and the material hazard are reflected in the RSPA severity definition. The amount of material available to be spilled is not reflected in the RSPA severity definition and is not proposed since bulk shipments would be overemphasized.

Effective January 1, 2005, the 5800.1 form will include a check-off box for a shipment found to be an undeclared hazardous materials shipment regardless of whether material is released. The undeclared shipment parameter is used as an adder to the incident severity parameter in the alpha version. This formulation makes an undeclared shipment of equal importance to an incident that is neither serious nor significant, and a larger weighting may be desirable.

Incidents that have occurred recently will be weighted more heavily than those that occurred in the more distant past. Values of 5 for the most recent 12 months, 4 for the next most recent 12 months, and so on are used as starting points in the alpha test version.

Multiple incidents within a short time frame are weighted more heavily. A weighting of n is recommended for incidents in the same 12-month span. Thus, each of 10 incidents in the same 12-month span would be weighted 10 times that of a single incident.

The purpose of a normalization weighting is to distinguish between a small shipper with a score that reflects a large percentage of problem shipments and a large shipper with the same score but that reflects a small percentage of problem shipments.

Enforcement Score

FMCSA, RSPA, and the other mode agencies may initiate enforcement action. The enforcement score is based on the data from each for highway shippers:

$$\text{Enforcement Score} = \sum (\text{Violation Severity} \times \text{Time Weighting} \times \text{Material Weighting} \times \text{Multiple Inspection Weighting} \times \text{Normalization Weighting})$$

BUSINESS CONFIDENTIAL

Mr. William Quade, Chief
HAZARDOUS MATERIALS SHIPPER PRIORITIZATION PROGRAM:
DESCRIPTION OF THE ALPHA TESTING ALGORITHM (GEMS 1232932)

Page 3
LR-110R4.03-01

The sum is over all applicable enforcements with a non-zero time weighting value. Violation severity varies with the regulation section cited. Three levels of severity are used with values of 5, 3, and 1 from most to least serious, respectively.

The material weighting reflects the relative hazard of the material, and the values in Table 1 are proposed for the minimal class/division data situation. As was the case for the incident score, the amount of material in the shipment is not considered since such weighting would overemphasize bulk shippers.

Multiple inspection weighting is used to temper the number of enforcement actions by the number of inspections. The multiple inspection weighting is the inverse of the number of all inspections in the 12-month span in which the enforcement action occurred.

The time and *normalization* weighting are the same as described previously.

Enforcement actions by agencies other than FMCSA are treated the same as those for FMCSA to the extent that data are available.

Incident and Enforcement Weighting

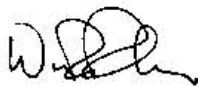
Three combinations of incident and enforcement weighting values have been incorporated into the alpha test versions:

- Incident = 10 and enforcement = 2
- Incident = 5 and enforcement = 2
- Incident = enforcement = 1

In these versions the incident severity weighting is 5,3, and 1 as described the incident section. A fourth alpha testing version is also available with the incident and enforcement factors listed in the second bullet and incident severity weighting factors of 50, 10, and 1.

Please call me at (865) 671-5854 if you have questions, concerns, or a need for additional assistance.

Sincerely,



William R. Rhyne

WRR:aln

Attachment

BUSINESS CONFIDENTIAL

Mr. William Quade, Chief
HAZARDOUS MATERIALS SHIPPER PRIORITIZATION PROGRAM:
DESCRIPTION OF THE ALPHA TESTING ALGORITHM (GEMS 1232932)

Page 4
LR-110R4.03-01

Table 1 Material Weighting Factors Used for Alpha Testing

Class and Division	Weighting Factor
1.1 Explosives – mass detonating 1.2 Explosives – projectile hazard 1.3 Explosives – fire hazard 2.1 Flammable gases 2.3 Toxic gases 7 Radioactive (HRCQ*)	10
1.5 Explosives – insensitive mass detonating 5.1 Oxidizing substances 6.1 Toxic substances	5
1.4 Explosives – no significant blast hazard 2.2 Non-flammable gases 4.1 Flammable solids 4.2 Spontaneously combustible material 4.3 Water reactive materials 5.2 Organic peroxides 7 Radioactive materials (except HRCQ)	2
1.6 Explosives – extremely insensitive 3 Flammable/combustible liquids 6.2 Infectious substances 8 Corrosive substances 9 Miscellaneous materials	1

*Highway Route Controlled Quantity

BUSINESS CONFIDENTIAL

ATTACHMENT 1
Shipment Score

A high number of shipments, particularly of high hazard materials, indicates a high risk. The source and type of shipment data to evaluate this score are uncertain at this point. The approach currently being pursued is that the data will be sought voluntarily through industry organizations.

If suitable data can be found for a significant number of shippers, a shipper score can be evaluated as:

$$\text{Shipment Score} = \sum (\text{Shipper Activity} \times \text{Material Weighting}).$$

The sum is over all materials shipped from the location of interest. The normalization weighting use in the incident and enforcements scores is the inverse of the shipper activity.

The minimum level of detail is the annual number of shipments from each location (a) for which the material manufacturer/forwarder/etc. is the shipper of record and (b) for which another party (e.g., material recipient/swapper/etc.) is the shipper of record. The next level of increased detail is to subdivide the material into HAZMAT classes and divisions as shown in Table 1. Further increased level of detail is desirable (e.g., adding whether the material is a toxic inhalation hazard or produces toxic gas upon contact with water), but there is a limit on the detail that can be considered nonproprietary.

For a large shipper, the number of shipments may be very large, and rather than using the actual number of shipments, four or five categories of number of shipments should be used. For example, a value of 1 could be assigned to 10 shipments or less, a value of 2 to the range of 10 to 50 shipments, etc.

APPENDIX E: RECRUITMENT E-MAIL, CONSENT FORM AND USER INTERVIEW #1 GUIDE

User Interview Participant Recruitment Email

[Date]

[Potential Interview Participant Name Here]
[Potential Interview Participant Position/Title]
Federal Motor Carrier Safety Administration (FMCSA)
1200 New Jersey Avenue SE
Washington, DC 20590

Dear [Name Here]:

My name is Andy Schaudt and I am a Research Associate at the Virginia Tech Transportation Institute (VTTI) in Blacksburg. You recently agreed to volunteer to be part of a Subject-Matter Expert Committee involving hazardous materials research with VTTI and FMCSA. During the first peer review meeting that was held on [INSERT PEER REVIEW MEETING #1 DATE HERE] you might recall the mentioning of some follow-on user interviews and the need for committee members participation. I am recruiting committee members to participate in two user interviews focused on the design and development of the HM Shipper Prioritization Program application. These interviews will last approximately 30 minutes each.

As a volunteer you will be a great advisor on the prioritization process you have experienced, current methods in use, and feedback on the application that we are developing. Although you will receive no monetary compensation, the benefit to you will be having direct input into the HM Shipper Prioritization Program which you will most likely use in the future.

If you would be willing to participate, please respond to this email or call Andy Schaudt at the contact information below.

Thank you, in advance, for your consideration of our request.

Sincerely,

Andy Schaudt, M.S.
Research Associate, Advanced Systems & Applications
Center for Truck and Bus Safety, VTTI
3500 Transportation Research Plaza
Blacksburg, VA 24061
Office: 540.231.1591
aschaudt@vtti.vt.edu

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants of Investigative Projects

Title of Project: User Interviews for the Development of Hazardous Materials (HM) Shipper Prioritization Program (User Interviews)

Investigators: Darrell Bowman, Andy Schaudt, Stephanie Baker, Andrew Marinik, & Blake Stoddard

II. THE PURPOSE OF THIS RESEARCH PROJECT

The Shipper Prioritization Program has been under development at the Federal Motor Carrier Safety Administration (FMCSA) since the early 1990s. Traditionally, FMCSA's shipper program has been driven by complaints. In the mid 1990s, an attempt was made to develop a performance-based prioritization for Hazardous Materials (HM) shippers, similar to a program called SafeStat for HM carriers, but at that point there was insufficient performance data to develop such a system. In response, FMCSA developed the HM Package Inspection Program (HMPIP) to focus on inspecting individual shipments of HM at the roadside or on carrier's docks. Based on package inspection data collected during HMPIP inspections, HM incident data, and improved departmental data identifying companies involved in shipping HM, FMCSA has begun a second effort to develop a performance-based prioritization of HM shippers.

The Virginia Tech Transportation Institute has been contracted to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program. This project is intended to help FMCSA successfully implement its HM Shipper Prioritization Program. The purpose of these user interviews is to establish the users' ultimate goals, expectations and requirements of the HM Shipper Prioritization Program.

II. PROCEDURES

You will be taking part in two user interviews in 2008. The purpose of the first user interview is to obtain feedback on the design of the HM Shipper Prioritization Program before development begins. The purpose of the second user interview is to obtain feedback during the development process in order to establish a simple and intuitive interface for the final application. These interviews will be conducted over the telephone with only yourself and a facilitator from VTTI. Each interview will take approximately 30 minutes. There will be a total of 3 to 5 participants, including you.

III. RISKS

There are no more than minimal risks involved with participation in this study. These risks include possible minor discomfort at sharing your opinions someone else during an interview. However, you are free to end your participation at any time if you become uncomfortable.

IV. BENEFITS

No promise or guarantee of benefits will be made to encourage your participation. You may find the interview discussion to be interesting and your participation may impact the development of the HM Shipper Prioritization Program.

V. EXTENT OF ANONYMITY AND CONFIDENTIALITY

The verbal responses you make during these meetings will be kept strictly confidential. Your name will not be associated with any comments that you make. Data collected will be stored at the Virginia Tech Transportation Institute and access to the data will be under the supervision of Darrell Bowman, Andy Schaudt, Stephanie Baker, Andrew Marinik, and Blake Stoddard. It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. COMPENSATION

Your participation will be completely voluntary. No compensation will be given.

VII. FREEDOM TO WITHDRAW

As a voluntary participant, you may withdraw at any time for any reason without penalty.

VIII. APPROVAL OF RESEARCH

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University.

IX. PARTICIPANT'S RESPONSIBILITIES

I voluntarily agree to participate in this study. I understand that I have the following responsibilities:

1. Listen to all of the committee leader's instructions.
2. Provide responses, as you are able, to the committee leader's questions.
3. Respect the opinions of others.

XI. PARTICIPANT'S PERMISSION

I have read and understand the requirements, procedures, and conditions of these user interviews. I have had all of my questions answered. I hereby acknowledge that by verbally agreeing during the first phone call that I am providing my voluntary consent to take part in this study.

If I participate in this study, I understand that I may withdraw at any time without penalty and that I may refuse to answer any questions. I agree to abide by the rules of this project.

Should I have any questions about this research or its conduct, I may contact:
Darrell Bowman @ (540) 231-1068, or by email: dbowman@vtti.vt.edu
Andy Schaudt @ (540) 231-1591, or by email: aschautd@vtti.vt.edu

If I should have any questions about the protection of human research participants regarding this study, I may contact Dr. David Moore, Chair of the Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email: moored@vt.edu; address: Research Compliance Office, 1880 Pratt Drive, Suite 2006 (0497), Blacksburg, VA 24061.

User Interview #1 Guide

I. Greeting

Hello, our names are _____ and _____. We are researchers at the Virginia Tech Transportation Institute. We want to thank you for taking the time to share your thoughts and opinions with us.

PURPOSE

- Purpose of this interview is to discuss issues related to the development of a shipper prioritization program.
- We're going to ask you a series of questions and need you to respond as openly and honestly as possible. There are no right or wrong answers—we just want your opinions.

CONFIDENTIALITY

- The discussion is strictly for research purposes, we are not selling anything and we will not connect anything you say with your name.
- We are recording the discussion so please speak loudly and clearly so that we get a good recording of your comments.
- We will make a transcript of our discussion, but we will not match the comments with names.
- If you feel uncomfortable, you can refuse to answer a question or you may stop the questioning at any time.

LOGISTICS

- This meeting will run for about 25-30 minutes. We are very appreciative of the time that you are spending and will honor it by not running over.

IMPLIED CONSENT

- Do you have any questions?
- Would you like to participate in this interview?
 - **If yes:** Thank you! I do want you to understand that by agreeing to participate in this phone interview you are consenting to take part in our study.
 - **If no:** Thank you very much for your time.

II. Preparation of Shipper List (15-20 minutes)

- Can you give a brief description of the process you use to prepare a list of the shippers you are going to inspect? For instance:
 - What are the steps you currently perform to establish a prioritization list?
 - What sources do you use to generate the list? Why these sources?
 - How long does it take you on average to prepare your list?
 - Do you think that this is a reasonable amount of time?
 - *If no ask:* How long do you think it should take to prepare the list?
 - How many shippers are usually on the list that you prepare?
 - Do you typically have the same number of companies on your list each time or does your list vary?
 - Is there a preferred number that you'd like to have on your list?
 - How often do you prepare a list (once a month, once a quarter, etc.)?
 - Would you like to be able to get the list more often? Less often?
 - Is there anything in particular that you find helpful about the process you currently use to prepare this list?
 - Is there anything in particular that you find problematic about the process you currently use to prepare this list?

III. EXPECTATIONS (5 minutes)

- What are your expectations for the Shipper Prioritization Program?
 - In your opinion, what would make this Shipper Prioritization Program a “success”?

APPENDIX F: USER INTERVIEW #2 GUIDE

User Interview #2 Guide

I. Greeting

Hello, our names are _____ and _____. We are researchers at the Virginia Tech Transportation Institute. We want to thank you for taking the time to share your thoughts and opinions with us.

PURPOSE

- Purpose of this interview is to discuss issues related to the development of a shipper prioritization program, in particular the program website.
- We're going to ask you a series of questions and need you to respond as openly and honestly as possible. There are no right or wrong answers—we just want your opinions.

CONFIDENTIALITY

- The discussion is strictly for research purposes, we are not selling anything and we will not connect anything you say with your name.
- We are recording the discussion so please speak loudly and clearly so that we can get a good recording of your comments.
- We will make a transcript of our discussion, but we will not match the comments with names.
- If you feel uncomfortable, you can refuse to answer a question or you may stop the questioning at any time.

LOGISTICS

- This interview will run for about 25-30 minutes. We are very appreciative of the time that you are spending and will honor it by not running over.

IMPLIED CONSENT

- Do you have any questions?
- Would you like to participate in this interview?
 - *If yes*: Thank you! I do want you to understand that by agreeing to participate in this phone interview you are consenting to take part in our study.
 - *If no*: Thank you very much for your time.

II. Reaction to Website Screen Shots (15-20 minutes)

- *After presentation of the website screen shots ask the following general questions:*
 - Please take a moment and look at these two screen shots and then let me know your thoughts and reactions to them?
 - Using these screen shots as a guide, describe to me how you would go about creating your own prioritization list?
 - After selecting your region/state and hitting submit (second screen shot), what type of information do you need to see in the resulting prioritization list that is created?
 - What, if anything, about these screen shots might be confusing or unclear to users?
 - What, if anything, needs to be added, deleted, or changed on either screen shot?
 - Is there anything about the website that you feel we should have discussed today, but haven't?

III. EXPECTATIONS (5 minutes)

- What are your expectations for the shipper prioritization program website?
 - In your opinion, what would make this shipper prioritization website a “success”?

IV. SAFESTAT (5 minutes)

- Now we would like to ask you a few questions about SAFESTAT?
 - First of all, do you use SAFESTAT?
 - *If so, ask:*
 - What do you use it for?
 - How often do you use it?
 - Do you have any insights from using SAFESTAT that could apply to the development of this website?

Thank you so much for your time and input on this project, it is greatly appreciated.



Shipper Prioritization Online Reporting Tool

Home Options Logout Help Search

Login

Please enter your username and password to access the prioritization tool.

Username:

Password:

Login

If you are having trouble logging into the system, you will need to contact your system administrator.

[Who is my system administrator?](#)

Shipper Prioritization

The online reporting tool for shipper prioritization has been created to aid in identifying those shippers with a greater need for immediate attention. A unique algorithm has been developed to account for various facets in the history of each shipper, and, by using that known information, attempts to predict the highest priority shippers with regards to inspections. The information utilized in the algorithms computation are pulled from several database locations:

- HMPIP - Hazardous Materials Package Inspection Program. (FMCSA)
- MCMIS - Motor Carrier Management Informaiton System. (FMCSA)
- EMIS - Enforcement Management Information System. (FMCSA)
- HMIRS - Hazardous Materials Incident Reporting System. (PHMSA)

The prioritization algorithm accounts for inspection history, enforcement history, and incident history of each shipper. The histories are weighted depending on the severity of the violation or incident, and the number of each that may have occurred over the last 3 years. This is a dynamic system, and thus, both the quality of information submitted and the quantity of informaiton help increase the overall accuracy of the prioritization scores.

Feedback

The accuracy and usefulness of this tool depend on the users. Your feedback allows constant improvements to this tool. Those in the field are the most knowledgable of the shippers and carriers being inspected. Please offer any comments you feel can better this tool for all.

Submit

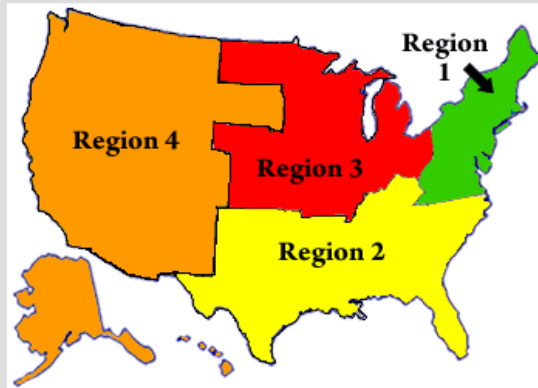
(C)FMCSA October, 2008

Shipper Prioritization Online Reporting Tool

Home Options Logout Help Search

Prioritize by Region.

The region you select will prioritize the shippers in that region. Please click on your region of interest below:



You can also manually select states and territories. Each shipper/carrier with a listed address in the selected regions will be added to the prioritization query. Once you have completed selecting the locations of interest, please click the submit button.

- | | | | | |
|---|--------------------------------------|--|--|---|
| <input type="checkbox"/> Alabama | <input type="checkbox"/> Alaska | <input type="checkbox"/> Arizona | <input type="checkbox"/> Arkansas | <input type="checkbox"/> California |
| <input type="checkbox"/> Colorado | <input type="checkbox"/> Connecticut | <input type="checkbox"/> Delaware | <input type="checkbox"/> Florida | <input type="checkbox"/> Georgia |
| <input type="checkbox"/> Hawaii | <input type="checkbox"/> Idaho | <input type="checkbox"/> Illinois | <input type="checkbox"/> Indiana | <input type="checkbox"/> Iowa |
| <input type="checkbox"/> Kansas | <input type="checkbox"/> Kentucky | <input type="checkbox"/> Louisiana | <input type="checkbox"/> Maine | <input type="checkbox"/> Maryland |
| <input type="checkbox"/> Massachusetts | <input type="checkbox"/> Michigan | <input type="checkbox"/> Minnesota | <input type="checkbox"/> Mississippi | <input type="checkbox"/> Missouri |
| <input type="checkbox"/> Montana | <input type="checkbox"/> Nebraska | <input type="checkbox"/> Nevada | <input type="checkbox"/> New Hampshire | <input type="checkbox"/> New Jersey |
| <input type="checkbox"/> New Mexico | <input type="checkbox"/> New York | <input type="checkbox"/> North Carolina | <input type="checkbox"/> North Dakota | <input type="checkbox"/> Ohio |
| <input type="checkbox"/> Oklahoma | <input type="checkbox"/> Oregon | <input type="checkbox"/> Pennsylvania | <input type="checkbox"/> Rhode Island | <input type="checkbox"/> South Carolina |
| <input type="checkbox"/> South Dakota | <input type="checkbox"/> Tennessee | <input type="checkbox"/> Texas | <input type="checkbox"/> Utah | <input type="checkbox"/> Vermont |
| <input type="checkbox"/> Virginia | <input type="checkbox"/> Washington | <input type="checkbox"/> West Virginia | <input type="checkbox"/> Wisconsin | <input type="checkbox"/> Wyoming |
| <input type="checkbox"/> American Samoa | <input type="checkbox"/> Guam | <input type="checkbox"/> Northern Marianas | <input type="checkbox"/> Puerto Rico | |

Submit

APPENDIX G: HM SHIPPER SEVERE VIOLATIONS

HM Shipper Severe Violations

Citation	Type	Description
107.608	Severe Level II	Offering a hazardous material for transportation without having registered with the Department of Transportation, under Subpart G of Part 107.

Citation	Type	Description
172.200(a)	Severe Level I	Offering a hazardous material without preparing a shipping paper. (Use for nothing prepared).
172.201(e)	Severe Level II	Offerer fails to maintain a copy of the HM shipping paper as prescribed for 375 days (two years after Jan 9, 2006) after the date accepted by the motor carrier.
172.202(a)	Severe Level II	Failing to enter the proper description of a hazardous material on a shipping paper. (Use for incorrect or incomplete shipping papers or to consolidate multiple shipping paper violations).
172.203(a)	Severe Level II	Failing to enter on a shipping paper the notation "DOT-E" followed by the exemption number.
172.203(c)(1)	Severe Level II	Failing to enter the hazardous substance constituent on a shipping paper when not identified by the proper shipping name.
172.203(d)	Severe Level II	Failing to include on shipping papers for a shipment of radioactive material physical and chemical form, activity, and category of label.
172.203(m)	Severe Level I	Failing to enter the words "Poison Inhalation Hazard" or "Toxic Inhalation Hazard" on the shipping paper when required.
172.203(n)	Severe Level II	Failing to enter the word "HOT" on the shipping paper for elevated temperature materials as required.
172.203(o)	Severe Level I	Failing to include the additional required information for organic peroxides or self reactive materials on shipping paper.
172.205(a)	Severe Level I	Offering a hazardous waste without a hazardous waste manifest.
172.205(a)	Severe Level II	Failing to properly prepare a hazardous waste manifest. (Use for an incorrect or incomplete hazardous waste manifest).
172.205(b)	Severe Level II	Failing to prepare the hazardous waste manifest in accordance with 40 CFR Part 262.
172.313(a)	Severe Level I	Failing to mark a package of hazardous materials with the words "Inhalation Hazard" when required.
172.301(a)(1)	Severe Level II	Failing to properly mark a non-bulk package of hazardous material with the proper shipping name and identification number.
172.320(a)	Severe Level II	Failing to mark a package containing Class 1 material with the appropriate EX-number. (Check for applicable exceptions before citing).
172.326	Severe Level II	Failing to properly mark a portable tank of hazardous materials with the proper shipping name and identification number.

172.326(c)(2)	Severe Level II	Failing to provide to a motor carrier the required identification numbers for a portable tank.
172.328(a)(1)	Severe Level II	Failing to provide to a motor carrier the required identification numbers for a cargo tank.
172.328(a)(2)	Severe Level II	Offering a cargo tank containing hazardous material that has not been marked with the required identification number.
172.400(a)	Severe Level II	Failing to properly label a package of hazardous materials.
172.403	Severe Level II	Failing to affix the correct label to a package of radioactive material.
172.506(a)	Severe Level II	Failing to provide the required placards to a motor carrier.
172.600(c)(1)	Severe Level II	Failing to provide emergency response information.
172.604(a)	Severe Level II	Failing to provide an emergency response telephone number.
172.604(a)(1)	Severe Level II	Failing to provide an emergency response telephone number that is monitored at all times that a hazardous material is in transit.
172.604(a)(2)	Severe Level II	Failing to provide the 24-hour emergency response telephone number of a person who is knowledgeable of the hazards and characteristics of the hazardous materials being shipped (of a person who does not have comprehensive emergency response and accident mitigation information).
172.704(a)	Severe Level II	Failing to train hazardous material employees as required. (Use when at least 10% of hazardous material employees are not trained as required).

Citation	Type	Description
173.21(a)	Severe Level I	Offering a forbidden material for transportation.
173.21(e)	Severe Level I	Offering for transportation materials, which if combined, would likely cause a dangerous evolution of heat, flammable or poisonous gas or vapor, or a corrosive material.
173.22(a)(2)	Severe Level I	Offering a hazardous material in an unauthorized package.
173.24(b)(1)	Acute	Transporting hazardous materials in a portable tank that has an identifiable release of hazardous materials to the environment.
173.24(b)(1)	Acute	Transporting hazardous materials in a cargo tank that has an identifiable release of hazardous materials to the environment.
173.24(b)(1)	Acute	Transporting hazardous materials in a non-bulk packaging that has an identifiable release of hazardous materials to the environment.
173.24(b)(2)	Severe	Offering for transportation a hazardous material in

	Level I	a package that resulted in the effectiveness of the package being substantially reduced.
173.24b(d)(2)	Severe Level I	Loading a cargo tank with a hazardous material that exceeds the maximum weight of lading marked on the specification plate.
173.25(a)(2)	Severe Level II	Failing to properly mark an overpack with the proper shipping name and ID number for materials contained within.
173.25(a)(2)	Severe Level II	Failing to properly mark an overpack with the proper labels for materials contained within.
173.25(a)(2)	Severe Level II	Failing to properly orient packages subject to the marking requirements of 172.312 in an overpack.
173.30/177.848(d)	Severe Level I	Loading hazardous materials not in accordance with the segregation table.
173.30/177.834(g)	Severe Level II	Failing to brace containers of hazardous materials to prevent relative motion between containers.
173.30/177.835(a)	Severe Level II	Loading into or on, or unloading a Class 1 (explosive) material from a motor vehicle with the engine running.
173.33(a)	Severe Level I	Offering or accepting for transportation a hazardous material in an unauthorized cargo tank motor vehicle.
173.33(a)(2)	Severe Level I	Transporting or loading two or more materials in a cargo tank motor vehicle that resulted in an unsafe condition (fire, explosion, etc.)
173.33(b)(1)	Severe Level I	Transporting in a cargo tank motor vehicle a hazardous material that had a dangerous reaction when in contact with the tank.
173.33(c)(5)	Severe Level I	Loading a division 6.1 material in a cargo tank having a maximum allowable working pressure of less than 25 psig.
173.33(e)	Severe Level I	Transporting (Division 6.1 material, oxidizer liquid, liquid organic peroxide, or corrosive liquid) in cargo tank piping without bottom damage protection devices meeting the requirements of § 178.337-10 or § 178.345-8(b).
173.33(e)	Severe Level I	Transporting (Division 6.1 material, oxidizer liquid, liquid organic peroxide, or corrosive liquid) in cargo tank piping while using a sacrificial device to satisfy accident damage protection requirements.
173.40(d)	Severe Level I	Offering a cylinder charged/filled with a poisonous material without providing additional protection as required.
173.301(d)	Severe Level II	Offering manifolded (interconnected) cylinders except as authorized.
173.301(e)	Severe	Offering a charged/filled cylinder that has a

	Level II	removable contamination in excess of 22 dpm/square cm.
173.443(b)	Severe Level II	Offering a package of radioactive material with removable contamination in excess of 220 dpm/square cm.
173.447	Severe Level I	Storing in one-area packages of radioactive material that exceed a total Transport Index of 50.
173.457(b)(3)	Severe Level I	Offering a fissile material, controlled shipment in a conveyance containing other packages of any Class 7 (radioactive) material required to bear one of the labels prescribed in 49 CFR 172.403.

APPENDIX H: USABILITY SCREENING QUESTIONNAIRE, E-MAIL TEMPLATES, INFORMED CONSENT FORM, PROTOCOL, DATA RECORDING SHEET, POST TASK QUESTIONNAIRE, POST TASK INTERVIEW, AND EXIT QUESTIONNAIRE

Usability Study Screening Questionnaire (Phone Script)
For the HM Shipper Prioritization Program project

Name of Company _____
Phone Numbers _____
Best Time to Call _____
Screener _____

Note to Researcher:

Initial contact between participants and researchers may take place over the phone. If this is the case, read the following Introductory Statement, followed by the questionnaire. Regardless of how contact is made, this questionnaire must be administered verbally before a decision is made regarding the participant's willingness and eligibility to participate in this study.

Introductory Statement:

After you call a prospective participant, use the following script as a guideline in the screening interview.

Hello. May I speak to: _____ (known individual's name)

If the point of contact is not available:

Could you tell me when a better time would be to contact (known individual's name)?

Better time to call back: _____

If a better time to call back is not given:

Thank you for your time. Goodbye.

PART FOR CONTACT WITH (known individual's name):

Hello. My name is _____ and I am a researcher at the Virginia Tech Transportation Institute (VTTI) in Blacksburg, VA. I am recruiting volunteers to participate in a new study funded by the Federal Motor Carrier Safety Administration. The project involves the development of a Hazardous Materials Shipper Prioritization Program focused on inspecting shippers. We need volunteers who are currently involved in determining which shippers of Hazardous Materials need to be inspected. I obtained your contact information from (choose appropriate identification).

Contact Source:

- FMCSA Website
- _____ (word of mouth contact) who recommended you as a possible participant.

Note to researcher: If respondent connects researcher to another point of contact repeat first section with that person.

If point of contact does not want to continue:

Thank you for your time. Goodbye.

If point of contact agrees to continue:

Great! Let me tell you more about our study.

The purpose of this project is to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program. The result of this study will be the implementation of a fully functioning web-based application for generating priority lists of shippers to be inspected.

If you choose to participate, you will be part of a usability study. Trained researchers will come to your place of business and set up a laptop containing the web-based application we are testing. You will be asked to complete several tasks on the website related to the creation of shipper prioritization lists. You will also have the opportunity to share your thoughts and opinions. The usability session will last no longer than one hour.

Unfortunately we cannot pay you for your participation as this is a project sponsored by FMCSA and you are an employee of FMCSA. However, the benefit to you will be having direct input into the HM Shipper Prioritization Program which you will most likely use in the future.

Do you have any questions about this project?

Would this be something that you would be interested in participating in?

If they indicate they are not interested: *Thank you for your time.*

If they indicated they are interested: *Great! First of all, I'd like to ask you some questions.*

If they remain interested, move to the following questions.

Questions

3. *I'd like to confirm that the name we have for you is correct (Read name and update if necessary)*

Name: _____

4. *I'd also like to make sure that I have the correct spelling for your name. I have (read and update):*

First: _____ Last: _____

Now I would like to ask you a few questions regarding the responsibilities of your position within FMCSA to make sure that you are eligible for this study.

1. What is your title @ FMCSA?

2. Are you currently involved in determining which shippers and/or shipper/carriers of Hazardous Materials need to be inspected in your region or state? And if so, can you please describe your current responsibilities in terms of this process of determining which shippers and/or shipper/carriers need to be inspected?

- **If they say “No”**—they are not currently involved in the process of determining which shippers need to be inspected—they are not eligible: *I am sorry but you are not eligible for this particular study as we need to conduct the usability tests with people who are currently involved in determining which shippers need to be inspected. But thank you very much for taking the time to answer my questions and for your interest in our study.*

- **If they say “Yes”**—they are currently involved in the process of determining which shippers need to be inspected—they are eligible: *Wonderful! Thank you for taking the time to answer all of my questions. I do have a few logistics to go over with you now.*

1. If you choose to participate, we would like to visit your facility on _____ (insert potential dates). Do any of these dates work for you?

- **If yes**, capture date and set up time.
 - **Time frame given:** _____

- **If no:** *Is there another day/time that is more convenient for you?*
 - **Time frame given:** _____

2. Is there a quiet room at your facility where we can hook up a laptop and do the testing?

3. So that we can have the appropriate equipment on hand, can you please tell me if you are right or left handed?

- **If left handed ask:** *Do you use your left or right hand to move your mouse?*

4. *May I have a phone number where you can be reached and the hours/days when it's best to call?*

5. *And may I have an e-mail where we may send a follow-up confirmation?*

Name _____

Phone Numbers: (_____) _____ Home Work Cell

 (_____) _____ Home Work Cell

E-mail: _____

Best time to call: Any Mornings Afternoons Nighttime Weekends

Other: _____

I/Andy will be e-mailing you to confirm the date and time of the usability study. I/Andy will also send you a copy of the Informed Consent Form for this project. Please take a moment to read it over and contact me/Andy by (provide a date that is at least 3 days from the date of this recruitment) if you have any questions or concerns or if you decide you would rather not take part in the study. After 3 days I/Andy will need to go ahead and make travel arrangements. Will you be in your office over the next 3 days and have a chance to look over the ICF?

- *If No: Find out when the participant will be in the office so that they can receive the ICF.*

Also, if you have any questions before our visit or need to contact us for any reason please call me/Andy Schaudt at 540-231-1591 and I/he will help you with anything you need.

Thank you so much for your time and we will be in touch very soon. Have a nice day!

If at any point in the screening they indicate that they are no longer interested:

Thank you for your time.

Usability Study Volunteer Verification Email

[Date]

[Potential Volunteer Name Here]

[Potential Volunteer Position/Title]

Federal Motor Carrier Safety Administration (FMCSA)

[Street Address]

[State, Zip Code]

Dear [Name Here]:

My name is Andy Schaudt and I am a Research Associate at the Virginia Tech Transportation Institute (VTTI) in Blacksburg, Virginia. I am recruiting volunteers to participate in usability testing for a new study funded by the Federal Motor Carrier Safety Administration, specifically volunteers that are involved in creating prioritized lists of Hazardous Materials (HM) shippers that need to be inspected.

Choose either:

You were recommended to us as a possible participant by _____.

We found your e-mail on the _____ website.

The purpose of this project is to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program. The result of this study will be the implementation of a fully functioning web-based application for generating priority lists of shippers to be inspected. If you choose to participate, you will be involved in testing a web-based application designed to prioritize HM shippers. As someone who creates these lists, we are hoping you can provide your feedback and opinions about the web-based application we have created. An added benefit to you will be the opportunity to provide direct input into the HM Shipper Prioritization Program which you will most likely use in the future.

This email was sent to you so that we could verify your correct contact information, specifically your phone number so that we can call you to ask a few questions about participation in the committee. Could you please provide us with your contact information as well as a convenient time for us to call and discuss the project for approximately 5 minutes?

Thank you, in advance, for your consideration of our request.

Sincerely,

Andy Schaudt, M.S.

Research Associate, Advanced Systems & Applications

Center for Truck and Bus Safety, VTTI

3500 Transportation Research Plaza

Blacksburg, VA 24061

Office: 540.231.1591

aschaut@vti.vt.edu

Usability Study Confirmation

[Date]

[Usability Study Volunteer Name Here]

[Usability Study Volunteer Position/Title]

Federal Motor Carrier Safety Administration (FMCSA)

[Street Address]

[State, Zip Code]

Dear [Name Here]:

My name is Andy Schaudt and I am a Research Associate at the Virginia Tech Transportation Institute (VTTI) in Blacksburg. Thank you for agreeing to participate in our usability testing of a Hazardous Materials (HM) Shipper Prioritization Program website. The testing is part of a new study funded by the Federal Motor Carrier Safety Administration.

This email is being sent to confirm that you will be participating on _____ (date) at _____ (time). I will be coming to your facility at this time and will bring my laptop. It will be helpful if we have a quiet room where we can set up the laptop and conduct the study. The testing should take one hour.

I am sending you a copy of the Informed Consent Form for this project. Please take a moment to read it over and contact me by (*provide a date that is at least 3 days from the date this e-mail is sent*) if you have any questions or concerns or if you decide you would rather not take part in the study. After 3 days I will need to go ahead and make my travel arrangements. Please also contact me if there is any problem with this date/time.

Sincerely,

Andy Schaudt, M.S.

Research Associate, Advanced Systems & Applications

Center for Truck and Bus Safety, VTTI

3500 Transportation Research Plaza

Blacksburg, VA 24061

Office: 540.231.1591

aschaudt@vti.vt.edu

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants of Investigative Projects

Title of Project: Usability Study for the Development of Hazardous Materials (HM) Shipper Prioritization Program (Expert Committee)

Investigators: Darrell Bowman, Andy Schaudt, Stephanie Baker, Andrew Marinik, Tammy Trimble, and Kelly Stanley

III. THE PURPOSE OF THIS RESEARCH PROJECT

The Shipper Prioritization Program has been under development at the Federal Motor Carrier Safety Administration (FMCSA) since the early 1990s. Traditionally, FMCSA's shipper program has been driven by complaints. In the mid 1990s, an attempt was made to develop a performance-based prioritization for Hazardous Materials (HM) shippers, similar to a program called SafeStat for HM carriers, but at that point there was insufficient performance data to develop such a system. In response, FMCSA developed the HM Package Inspection Program (HMPIP) to focus on inspecting individual shipments of HM at the roadside or on carrier's docks. Based on package inspection data collected during HMPIP inspections, HM incident data, and improved departmental data identifying companies involved in shipping HM, FMCSA has begun a second effort to develop a performance-based prioritization of HM shippers.

The Virginia Tech Transportation Institute (VTTI) has been contracted to review, document, and recommend improvements to FMCSA's HM Shipper Prioritization Program. This project is intended to help FMCSA successfully implement its HM Shipper Prioritization Program. The purpose of this usability study is to test the HM Shipper Prioritization Program application that has been developed. Overall, five participants from different regions of the United States will be involved in this usability study. Participants will have some role in the development of lists of the Shippers and/or Shipper/Carriers that need to be inspected.

II. PROCEDURES

You will be taking part in a usability test of the web-based application that has been created by VTTI to prioritize the HM shippers and/or shipper/carriers that need to be inspected. The website is a prototype, not a "live" website. You will not be asked to enter your user name or password into the website. The test will take a maximum of one hour to complete. During that time you will be asked to perform three tasks on the website. After each task you will be asked several questions and will have an opportunity to share your thoughts and opinions about how the website works. At the end of the test session you will be asked to fill out a brief exit questionnaire.

III. RISKS

There are no more than minimal risks involved with participation in this study. The risks are similar to those encountered when conducting computer-based tasks at your workplace.

However, you are free to end your participation at any time if you become uncomfortable for any reason.

IV. BENEFITS

No promise or guarantee of benefits will be made to encourage your participation. You may find the usability study to be interesting and your participation may impact the development of the HM Shipper Prioritization Program.

V. EXTENT OF ANONYMITY AND CONFIDENTIALITY

The verbal responses you make during this usability study will be kept strictly confidential. Your name will not be associated with any comments that you make. Audiotapes used during this usability study will be transcribed and then erased. Your movement through the prototype website will also be recorded but the results of your activity will not be associated with your name. Data collected will be stored at the Virginia Tech Transportation Institute and access to the data will be under the supervision of Darrell Bowman, Andy Schaudt, Stephanie Baker, Tammy Trimble, Kelly Stanley, and Andrew Marinik. It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. COMPENSATION

Your participation will be completely voluntary. No compensation will be provided.

VII. FREEDOM TO WITHDRAW

As a voluntary participant, you may withdraw at any time for any reason without penalty.

VIII. APPROVAL OF RESEARCH

This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic Institute and State University.

IX. PARTICIPANT'S RESPONSIBILITIES

I voluntarily agree to participate in this study. I understand that I have the following responsibilities:

1. Listen to and follow, as best I can, the researcher's instructions.
2. Provide responses, as best I can, to the researcher's questions.
3. Fill out the brief exit questionnaire at the end of the session.

XI. PARTICIPANT'S PERMISSION

I have read and understand the requirements, procedures, and conditions of the usability study. I have had all of my questions answered.

If I participate in this study, I understand that I may withdraw at any time without penalty and that I may refuse to answer any questions. I agree to abide by the rules of this project.

Participant's name (Print)	Signature	Date
----------------------------	-----------	------

Researcher's name (Print)	Signature	Date
---------------------------	-----------	------

Should I have any questions about this research or its conduct, I may contact:

Darrell Bowman @ (540) 231-1068, or by email: dbowman@vti.vt.edu
Andy Schaudt @ (540) 231-1591, or by email: aschautd@vti.vt.edu

If I should have any questions about the protection of human research participants regarding this study, I may contact:

Dr. David Moore, Chair of the Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email: moored@vt.edu; address: Research Compliance Office, 1880 Pratt Drive, Suite 2006 (0497), Blacksburg, VA 24061.

USABILITY STUDY PROTOCOL

Test Set-up and Informed Consent Process

- Greet participant and ask where the laptop can be set up.
- Give the participant the Informed Consent Form (ICF) and ask them to read it over carefully.
- Set up laptop, mouse, and keyboard while the participant is reading over the ICF.
- Load website and make sure the site is working correctly.
- Ask the participant if they have any questions about the ICF specifically or the project in general.
- Have participant sign 2 copies of the ICF. Give one to the participant and keep one for VTTI records.

Opening Directions:

In front of you is a laptop with the prototype Hazardous Materials Shipper Prioritization Program website. Because this is a prototype website you will only be able to complete the tasks that we have designed for this particular test session.

During this test session I am going to ask you to complete three tasks. Please remember that we are testing the website, not you. We want your honest feedback so that we can find out how well the system meets the needs of the people who will be using it—people like you! So please take as long as you need for each task and don't worry about making mistakes.

Because we are trying to see how you go about completing the task, please try to do each task without my input. Then after the task is completed you will have an opportunity to share your comments. Of course if you need help, please feel free to ask me for assistance.

Are you ready to get started?

If yes--go to **"Familiarization Period"**

If no—answer questions if possible about the testing and record what questions were asked.

- Check watch and note start time. Make sure and finish testing within one hour.

**HM Shipper Prioritization Program Usability Study
OBSERVATION/RECORDING SHEET**

PARTICIPANT CODE _____

- **TEST START TIME** _____
- **TEST FINISH TIME** _____

Familiarization Period (Page 1):

I would like you to take a few minutes to familiarize yourself with the information on this first page. Just let me know when you are ready to move on to the next page.

Note how long the participant takes: _____

- Participant Comments regarding Page 1:

Thank you. Now please move to the next page.

Task 1: The first task I have for you is to use this page to create a prioritization list of Shippers for the State of Florida. [Time Check: 5 min]

- Time to Complete Task 1 (Efficiency Measure):
 - **Start** _____ **End** _____ (**Total Time**_____)

- Number of times user expressed frustration or satisfaction (Satisfaction Measure):
 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

- Frustration Count: _____ Satisfaction Count: _____

- Other Comments:

- Task completion or failure (Effectiveness Measure)
 - Successful Completion: Y/N
 - Application Error: Y/N
 - User Error: Y/N

Task 2: Now please use this page to create a prioritization list for the Eastern Service Center area for Shippers. [Time Check: 15 minutes]

- Time to Complete Task 2 (Efficiency Measure):
 - **Start** _____ **End** _____ (**Total Time**_____)

- Number of times user expressed frustration or satisfaction (Satisfaction Measure):
 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

- Frustration Count: _____ Satisfaction Count: _____

- Other Comments:

- Task completion or failure (Effectiveness Measure)
 - Successful Completion: Y/N
 - Application Error: Y/N
 - User Error: Y/N

Task 3: Finally, please use this page to create a prioritization list for the entire U.S. for Shippers. [Time Check: 25 minutes]

- Time to Complete Task 3 (Efficiency Measure):
 - **Start** _____ **End** _____ (**Total Time**_____)

- Number of times user expressed frustration or satisfaction (Satisfaction Measure):
 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

 - Comment: _____
 - Frustration/Satisfaction

- Frustration Count: _____ Satisfaction Count: _____

- Other Comments:

- Task completion or failure (Effectiveness Measure)
 - Successful Completion: Y/N
 - Application Error: Y/N
 - User Error: Y/N

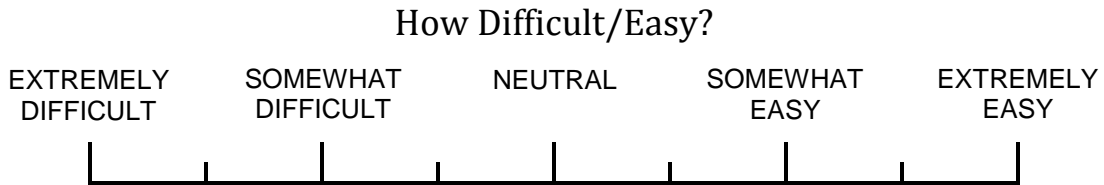
Post Task Questionnaire

IRB Note: Questions will be presented on individual sheets.

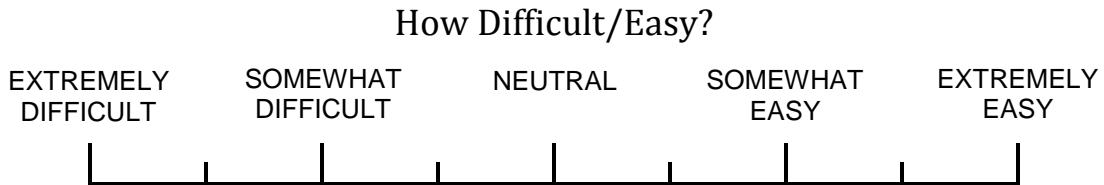
Verbal directions: *Please choose a vertical line on the scale below.*

Please choose the vertical line on the scale below that best matches your opinion.

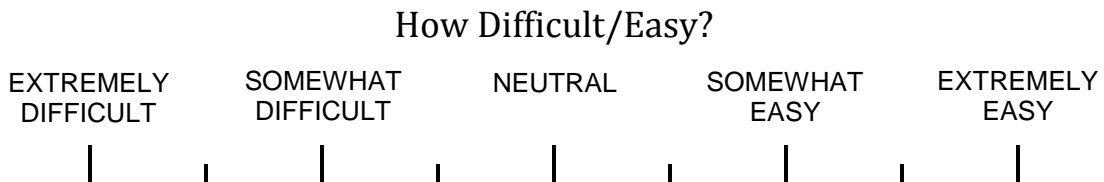
1. How difficult/easy was the task of prioritizing the list of Shippers for Florida?



2. How difficult/easy was the task of prioritizing the list of Shippers for the Eastern Service Center area?



3. How difficult/easy was the task of prioritizing the list of Shippers for the entire U.S.?



Post-Task Interview

IRB Note: These are primary probes.

Secondary probes may be used but will not stray from this general line of questioning.

- After each post-task questionnaire:
 - If answer is NOT Extremely Easy ask participant: *What could be done to make this task easier to perform?*

- *Are there any comments that you have regarding this task?*

- After final task also ask: **[Time Check: 35 minutes]:**
 - Out of the three prioritized lists that you created, which style would you be most likely to use in your job? Let's go back for a moment and re-create that list.
 - Shipper by State (example: Florida)
 - Shipper Service Center Area (example: Eastern Service Center)
 - Shipper for U.S.
 - Is there another type of prioritized search that you wanted to be able to conduct but were not able to do with this format?

- Is the number of companies that we have on this list suitable? If not, how many would you like to appear?

- Is the information displayed in this prioritization table what you need prior to going out to inspect? If not, what information is missing that you still need to collect before you can go out to inspect?

- Do you think that a help/tutorial page would be useful for this website?

- Other comments/questions?

After Post-Task Interview is completed, hand out Usability Exit Questionnaire

[Time Check: 50 minutes]

Exit Questionnaire

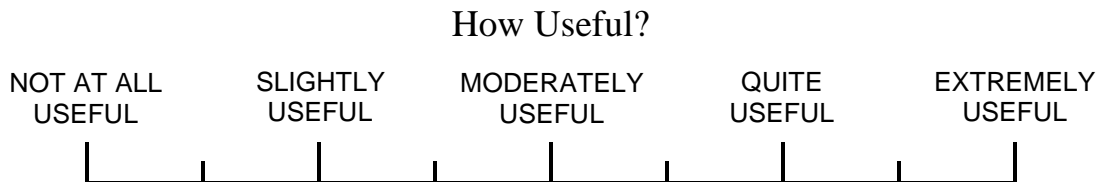
Please answer the following questions using the blanks provided.

1. Are you Male or Female? _____
2. What is your age? _____
3. How long have you been creating these prioritization lists for shippers? _____

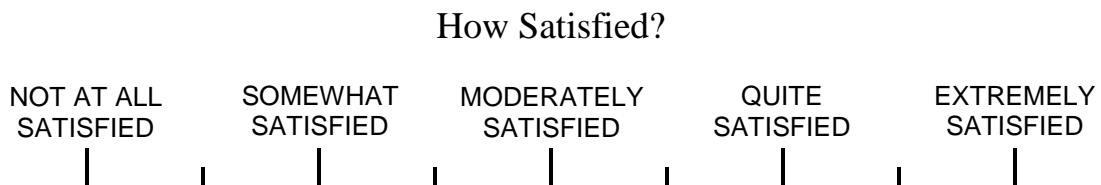
Verbal directions: *Please choose a vertical line on the scale below.*

Please choose the vertical line on the scale below that best matches your opinion.

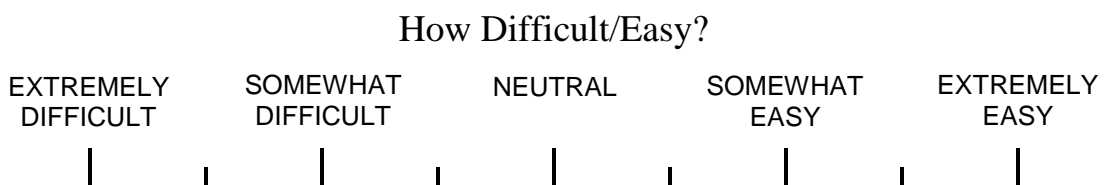
4. How useful did you find this HM Shipper Prioritization Program website?



5. How satisfied were you with the HM Shipper Prioritization Program website?

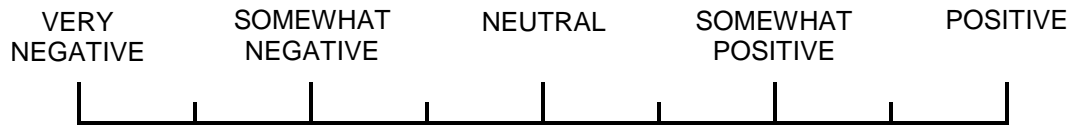


6. Overall, how difficult/easy was prioritizing lists with this website?



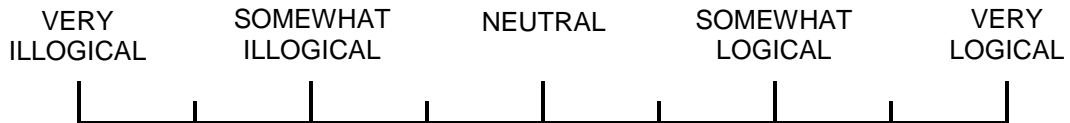
7. What was your overall reaction to the interface?

Your Reaction?



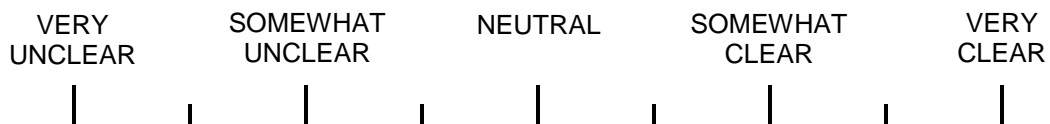
8. What was your overall impression regarding the arrangement of information?

Arrangement of Information?



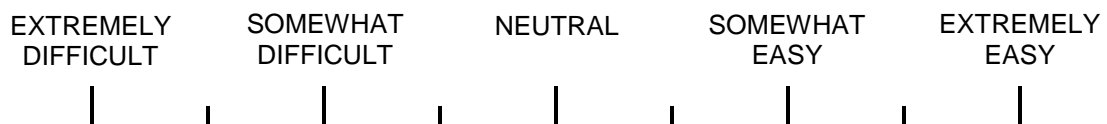
9. What was your overall impression regarding the use of terminology?

Terminology Used?

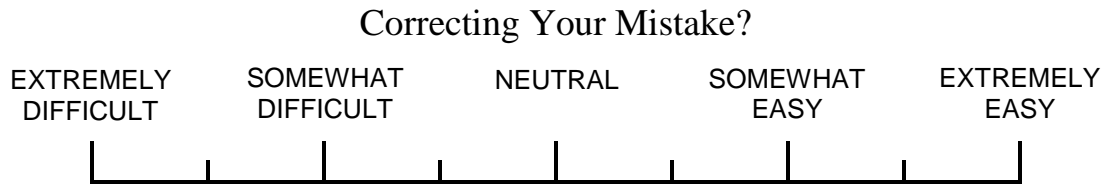


10. What was your overall impression regarding learning to use this site?

Learning to Use?



11. What was your overall impression regarding the ability to correct your mistakes?



12. Please provide any additional information that you think would be helpful to the researchers working on this project.

Thank you for your participation!

APPENDIX I: TABLE OF MATERIAL WEIGHTING FACTORS

Material Weighting Factors

Class and Division	Weighting Factor
1.1 Explosives - mass detonating	10
1.2 Explosives - projectile hazard	10
1.3 Explosives - fire hazard	10
2.1 Flammable Gases	10
2.3 Toxic Gases	10
6.1 Toxic Substances - Zones A and B	10
7 Radioactive [Highway Route Controlled Quantity(HRCQ)]	10
1.5 Explosives - insensitive mass detonating	5
4.3 Water Reactive Materials	5
5.1 Oxidizing Substances	5
5.2 Organic Peroxides	5
6.1 Toxic Substances - except Zones A and B	5
1.4 Explosives - no significant blast hazard	2
2.2 Non-flammable Gases	2
3 Flammable/Combustible Liquids	2
4.1 Flammable Solids	2
4.2 Spontaneously Combustible Materials	2
7 Radioactive (except HRCQ)	2
1.6 Explosives - extremely insensitive	1
6.2 Infectious Substances	1
8 Corrosive substances	1
9 Miscellaneous materials	1