

Office of Hazardous Materials Safety
Research and Development

Strategic Plan



2012-2017



U.S. Department of Transportation
Pipeline and Hazardous Materials
Safety Administration

Office of Hazardous Materials Safety
Research and Development

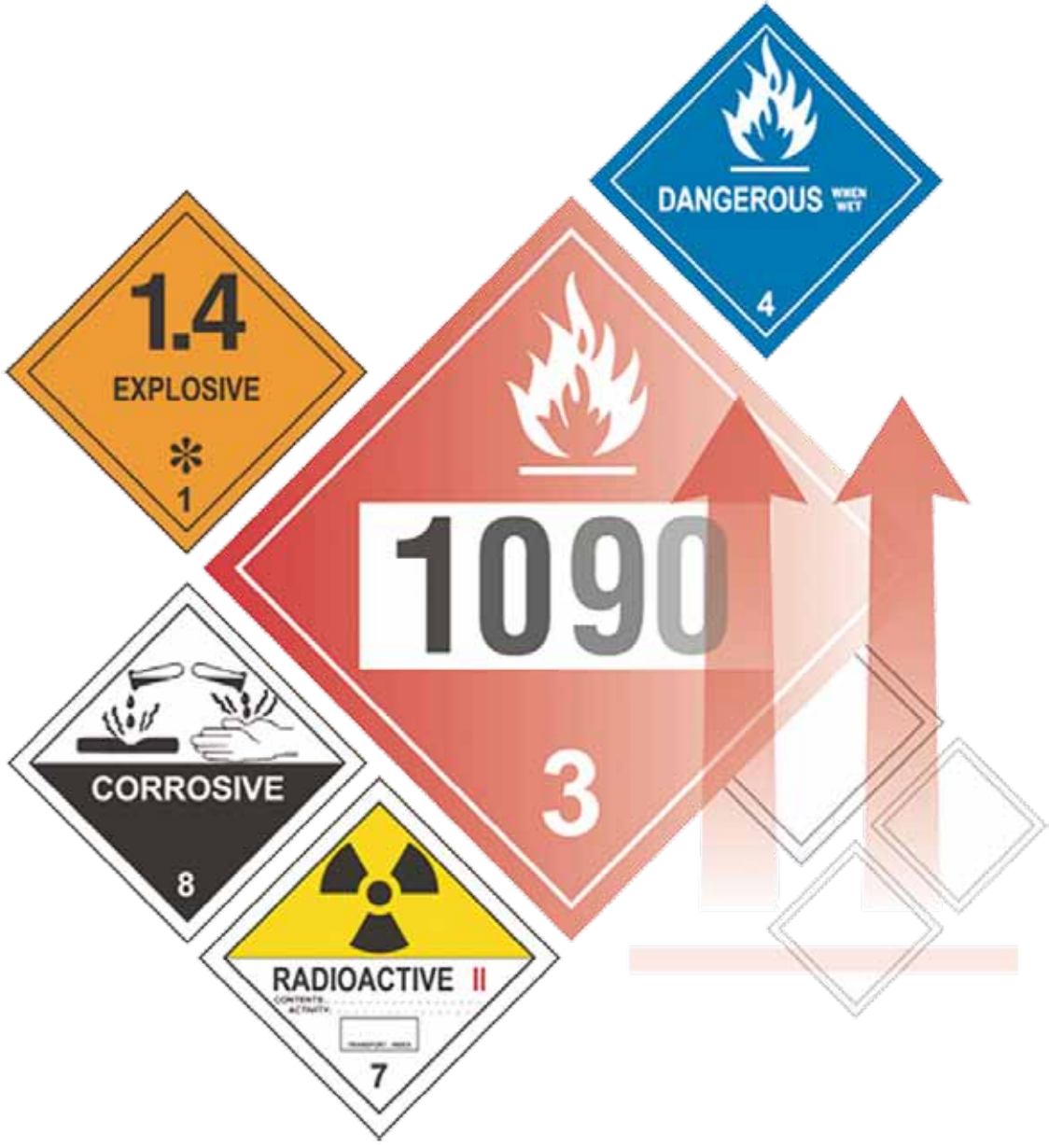
Strategic Plan





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Executive Summary

EXECUTIVE SUMMARY

Research and Development (R&D) is an investment in shaping the future of an organization. An effective R&D strategic plan is necessary to focus on initiatives that produce the best return on investment. The Office of Hazardous Materials Safety's (OHMS) R&D strategic plan directs basic and applied research for the purpose of minimizing risks associated with the transportation of hazardous materials (HM). Chemical compositions, enhanced logistics and communications, complex packaging material designs, and improved defect detection technologies are advancing exponentially and, as a result, have placed a greater demand on R&D resources to ensure that safety systems and regulations keep pace with innovations.

Team Work

The goal of the OHMS R&D program is to enhance the safety mission. This R&D strategic plan strengthens the ability to implement technological successes in new package designs and evaluations; identify potential needs, gaps, and vulnerabilities, and identify visionary and cross-cutting research to mitigate risks in the transportation of HM.

The main objective of the Office of Hazardous Materials Safety (OHMS) research program is to identify and mitigate the emerging risks associated with the transportation of HM and better understand the factors contributing to these risks. The R&D program determine ways to minimize the potential impacts from various risks. The vision is to promote innovative approaches to support the safe transportation of HM in multimodal transportation system.

The Engineering and Research Division's research efforts are categorized into five research priorities designed to supply the information necessary to guide future changes in regulations, industry safety practices, and global intermodal transport efficiency demands for HM. The five research priorities are:

- Package Integrity,
- Human Factors,
- Technical Analysis to Aid Risk Assessments,
- Risk Management and Mitigation, and
- Emerging Technologies.



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1.0 Introduction

During the past 50 years, there have been significant economic and demographic changes that could not have been anticipated when the U.S. Interstate transportation system was initially created. Since 1956, the U.S. population has increased by more than 56 percent and the Gross Domestic Product increased 24 percent. The amount (tonnage) of hazardous materials shipped by all modes increased by about 25% from 1997-2007, while the value of these shipments (adjusted for inflation) doubled.¹

These changes demonstrate a greater dependency on the efficiency and effectiveness of the safe transportation of HM. Certainly, many of the HM programs and policies crafted more than a half century ago cannot meet the demands of today's transportation needs. An effective transportation safety program requires continuous evaluation, revitalization, and updating to address modern risks. The implementation of the OHMS R&D program is another tool in the Pipeline and Hazardous Materials Safety Administration's (PHMSA) program to address these ever-changing needs of the safe transportation of HM.

This strategic plan is designed to address program operations and focus R&D funds on projects that meet the Office of Management and Budget's (OMB) definition of basic and applied research.

The OHMS Engineering and Research Division is in the initial stages of establishing a comprehensive Research and Development program. The present and future demand for the transportation of HM requires a vision, greater accountability, and forward-thinking approaches to address new challenges of HM commerce. The Department of Transportation's (DOT) RD&T Strategic Plan identified HM safety as a critical element. As such, this R&D strategic plan aligns with the DOT's Strategic Plan to ensure consistency.

2.0 Mission and Vision

The mission of the Engineering and Research's R&D Office is to provide the technical information, analyses, and research needed to manage the public risk associated with HM transportation; provide the analytical foundation for regulatory and outreach activities; enhance multi-modal enforcement initiatives; and provide alternative opportunities for training development.

The main objective of the OHMS research program is to identify and mitigate the emerging risks associated with the transportation of HM and better understand the factors contributing to these risks. The R&D Program will help determine ways to minimize the potential impacts from various risks.

The vision of the Engineering and Research's R&D office is to promote innovative approaches to support the safe commerce of hazardous materials for a multi-modal transportation system.

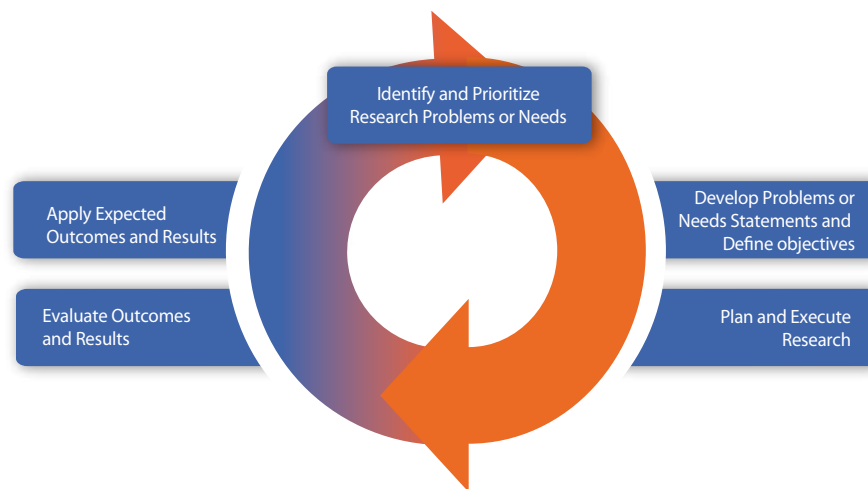


3.0 Program Planning and Investment

This strategic plan will provide the foundation for an R&D program that is performance based. The components of the R&D program are interdependent of each other. The interdependent cycle is a method to maximize results, effectively allocate funding, and ensure accountability as displayed below, the R&D program will allow five aspects to drive the program forward where information is cycled to ultimately determine if research adequately addresses risks. This approach provides an explanation of what, how and why it drives OHMS's Research and Development Program.

The R&D office is focused on products that institute practices and principles supporting the organization's mission. Once these products have been produced, an evaluation will be performed to determine if OHMS's efforts and outcomes have been captured.

The evaluation process will be conducted by a peer review of OHMS division officers involved in the development of the R&D initiative. Specifically, the OHMS Program Development Division (PHH-60) will be involved in evaluations of R&D to further enhance future HM program initiatives and budget justifications. The R&D office will ensure products and outcomes are transitioned into implementable results.



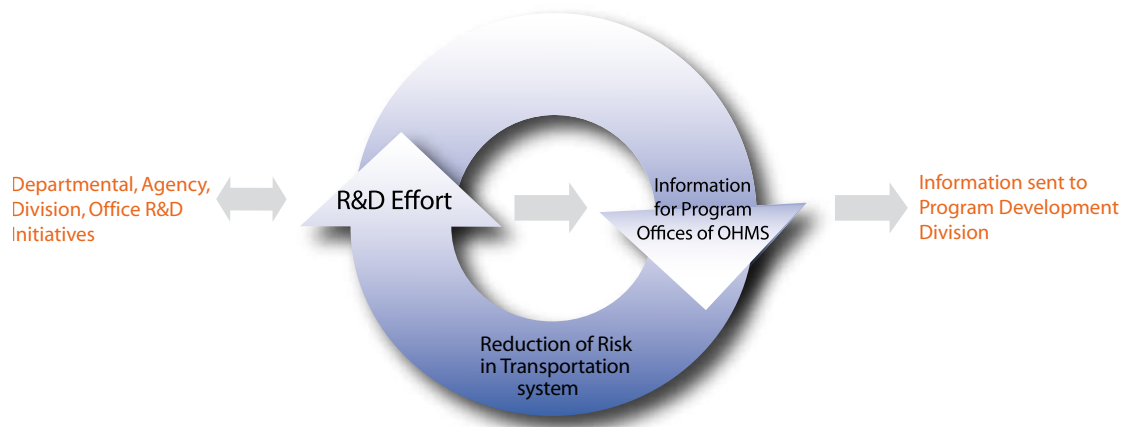
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4.0 Research and Development Strategic Approach

PHMSA administers national and international safety programs designed to protect the general public and the environment from HM risks within the transportation system. We prevent failures where we can, and reduce the consequences of failures that do occur. As with the Departmental RD&T plan and the PHMSA Strategic Plan, this R&D strategic plan will be used to guide policies, underpin rulemakings, advance training, research data, develop and enhance innovations, and address complex risk issues.

The diagram below demonstrates the R&D program's strategic approach to meet the objectives of the Department, Administration and OHMS needs. The development of the research program empowers the OHMS's Program Development Division to obtain information to identify vulnerabilities and gaps. Through the R&D program, the research information will be used to assist in developing OHMS's budget, devise objectives and goals, and improve business and operations plans to address HM safety risks within the transportation system.

The list of strategies below, in conjunction with the processes on page 9, will provide OHMS with an approach to developing policies concerning the safe transportation of HM.



Strategies:

- Study critical aspects and issues,
- Plan and effectively communicate internally among PHH offices,
- Evaluate new theories and concepts to minimize or prevent risks in HM transportation,
- Research critical data to identify and address HM risks, and
- Research emerging technologies to prevent potential HM incidents.

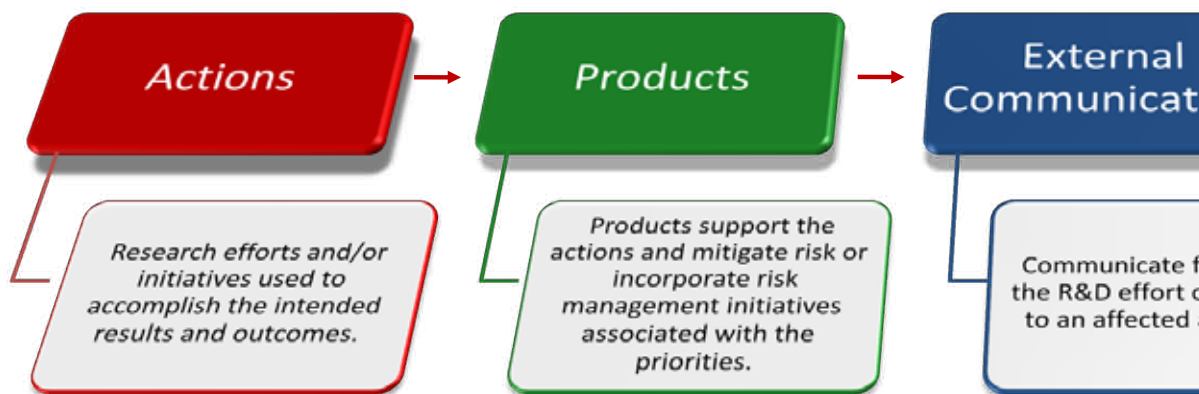
5.0 Research and Development Program Model

The management of the OHMS R&D program requires a process consisting of five elements of importance: Actions, Products, External Communication, Immediate Benefits, and Long Term Impacts. The implementation of these elements will sustain the R&D program through its longevity.

Priorities are the research initiatives that will be used to accomplish our safety mission. The R&D priorities are designed to support the program model. The research priorities each have a explanation of importance, goal, and products.

Products are the anticipated outcomes of the R&D effort. Products are created to our priorities and mitigate risk or incorporate risk management initiatives. The Engineering and Research Division expects that the products will support initiatives in other program areas of the OHMS. The products are implementable performance measurement tools to support the safety mission.

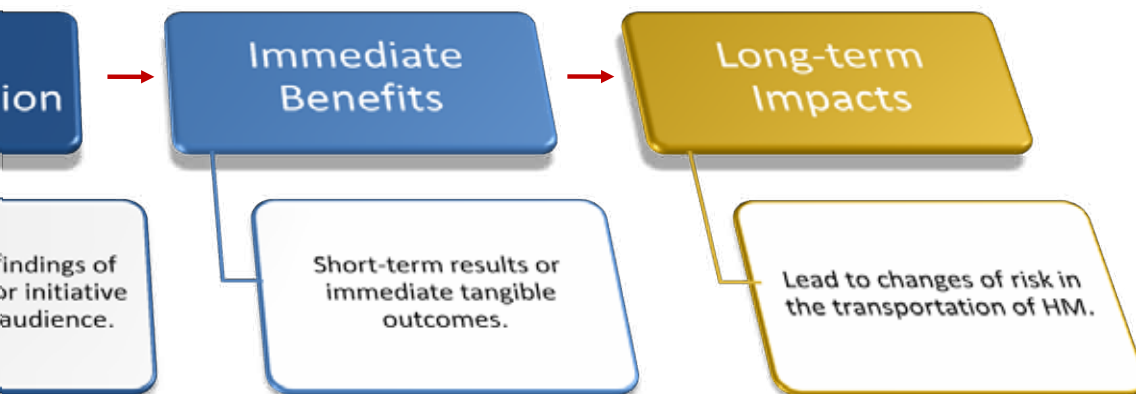
External Communications afford the opportunity to communicate findings of the R&D initiative to interested parties. The Engineering and Research Division has identified various forums to communicate R&D efforts and initiatives. The initial campaign began in FY 2011 and was launched in



conjunction with the Multimodal Hazardous Materials Training Seminars. In an effort to more effectively communicate HM research efforts, we established an HM R&D webpage.

Immediate Benefits are best described as short-term results or immediate tangible outcomes. This stage of the model shows results that are immediately used to address specific program needs. As R&D initiatives are created, this stage within the model reveals the return on investment (ROI).

Long-Term Impacts lead to changes of risk in the transportation of HM. The key to ensuring that Long-Term Impacts are effective is to benchmark the current status of issues and determine the effects over a performance period of a minimum five to ten years. The measured effects over the performance period will then be evaluated to determine if there was a reduction of, or impact to, the risks. This stage of the program model will afford the Engineering and Research Division an opportunity to examine the effectiveness of the research conducted and gather additional research needs.



6.0 Research and Development Priorities

There are five research and development priorities that address transportation safety risks. The priorities are depicted below:



6.1 Package Integrity

Why is it Important?

Packaging is an essential component of the HM transportation regulations, which cover a vast scope of materials and applications. Packages vary in size, weight, capabilities, and design--being as small as an aerosol can or as large as a railway tank car. Package integrity is a critical factor in ensuring that the public, transportation workers, and emergency responders are protected from the risk of exposure to HM during transportation. A package failure can lead to a wide range of adverse consequences depending on the type and quantity of material released. As such, it is imperative that evolving research efforts and initiatives are implemented to ensure packages maintain their integrity throughout the transportation systems.



OHMS has identified the improper or inadequate use of packaging to be one of the greatest risks identified within the transportation of HM. For this reason, the Engineering and Research Division is devoting resources to focus specifically on packages, researching external factors impacting package integrity, and examining new technologies with the potential to enhance HM packaging integrity.

What is the goal?

The goal of this priority is to prevent and reduce HM incidents resulting from package failures through improving standards related to manufacturing, testing, evaluating, and inspections.

What do the products provide?

- Enhanced testing and inspection processes,
- Analysis of package design, construction, and manufacturing, and
- Improved package performance standards.



Research and Development Priorities

6.2 Human Factors

Why is this important?

Human factors involve the study of the way humans relate to the world around them thus, are a common element in many incidents involving the release of HM. Human error is the fourth most-cited cause of failure for HM incidents.² OHMS created this priority to examine human involvement in the release of HM, research regulations that involve human impact related to the transportation of HM, and develop new strategies to reduce human handling errors. This is an involved science taking into account multidisciplinary fields including psychology, engineering, industrial design, operations research, and other imbedded aspects of human behavior. This research priority will focus on improving operational HM performance and safety through life costs, and adoption through improvement in the experience of the stakeholders. Although historically overlooked in HM transportation safety research, the Engineering and Research Division views this type of research essential as the safe transportation of all HM involves human interaction within the transportation system.



What is the goal?

The goal of this priority is to further improve the safety aspects of human involvement in HM transportation through enhancing programs involving human factors management.

What do the products provide?

- Better understanding of human interaction while handling HM,
- Improved outreach methods and best practices to HM industry, and
- Understanding of root cause failure for human actions in HM incidents.

6.3 Technical Analysis of Risks

Why is this important?

Looking at risks in different ways by utilizing different conceptual models and frameworks is helpful when examining activities, events, or incidents. One framework that has been used successfully in the Department of Transportation in preventing injury is the Haddon Matrix. The framework was devised in the 1970s by William Haddon, Jr., MD, who served as the first administrator of what is now the National Highway Traffic Safety Administration (NHTSA). Dr. Haddon pioneered the view that safety countermeasures should be subject to scientific scrutiny.

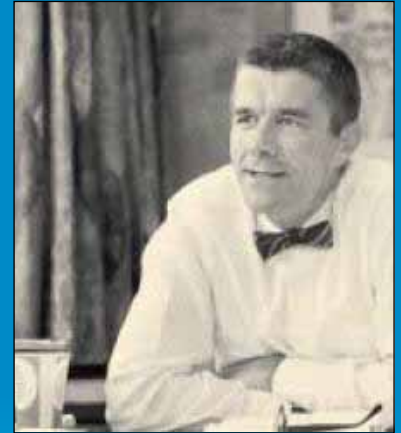
The Engineering and Research Division envisions frameworks such as these to be beneficial in determining how to reduce risks within the HM program and will explore various research efforts involving data to address HM risks in the various phases of transportation.

What is the goal?

The goal of this priority is to identify options to prevent fatalities and injuries resulting from HM incidents in transportation. The options will be quantifiable through scientific examination and research. The effort also will identify gaps and vulnerabilities within the HM program that will be filtered into other program needs such as rulemaking, field operations, and training.

What do the products provide?

- Understanding of patterns or anomalies within HM transportation,
- Improving regulations and standards,
- Introducing new technology in the safe transportation of HM, and
- Enhancing systems for improved HM information.



Former NHTSA Administrator William Haddon, Jr., MD

By the 1960s a growing number of influential advocates held broader views of highway safety than those espoused by the then “road safety establishment.” One of the most influential of these pioneers was William Haddon, Jr., a physician and editor of *Accident Research* (1964), the first compendium of important and illustrative examples of research in this area. A mainstay of the views of Haddon and his colleagues was that highway safety countermeasures should be subject to scientific scrutiny. These newer views became so influential that in 1967 the U.S. Congress enacted legislation that transformed efforts to reduce motor vehicle crash deaths and injuries. For the first time, the federal government assumed significant power to regulate motorist behavior (such regulation previously had been handled exclusively at the state level) and to set safety standards for new vehicles and highways. Haddon became the first federal highway safety chief.

6.4 Risk Management and Communication

Why is this important?

Risk management can be defined as the identification, assessment, and prioritization of risks followed by a coordinated and deliberative application of resources to minimize, monitor, and control the probability and impact of events. It is a systematic methodology that considers known factors and the impact that uncertainty plays in an outcome. This is where R&D plays a critical role in mitigating risks. The establishment of this priority provides the Engineering and Research Division with the ability to analyze information, determine the level of uncertainty, and mitigate the impact of an event(s). The R&D program use this priority to determine an awareness of the potential issues and an understanding of consequences related to the events experienced in the transportation environment. While the transportation of HM is conducted by trained HM professionals, the public is not fully aware of the impacts, much less the hazards, of these types of goods and services. The outcome from this priority will provide external stakeholders with valuable information to use or initiate self-corrective measures to address HM risks. Currently, OHMS's R&D program is not effectively communicated publically nor has it been centralized for distribution; as a result, the effectiveness of the R&D program has not been use at its fullest potential. This strategic plan is created and designed to communicate efforts of the R&D program and provides the guidelines to effectively accomplish this.

What is the goal?

The goal of this priority is to reduce the probability of HM incidents within the transportation system. This goal encompasses the ability to alleviate potential consequences of HM risks throughout the transportation network.

What do the products provide?

- Identify new potential risk assessments,
- Effectively communicate risks and increase awareness,
- Incorporate preventative measures in HM policies,
- Address gaps and vulnerabilities with agency programs, and
- Profile HM consequences.

6.5 Emerging Technologies Risk Mitigation

Why is this important?

The commitment to innovation and government research has provided the foundation to new emerging technologies. Specifically, innovation and government research has provided understanding solutions to address national and global concerns. This priority will encompass an approach to understanding emerging technologies, explore current and past technologies, and develop innovative piece of technology to ensure that HM risks are addressed within the transportation system.

What is the goal?

The goal of this priority is to identify and access past, existing, and emerging technologies to improve HM safety and further minimize HM risks.

What the products provide?

- Improved understanding of new materials and technologies,
- Ability to create or identify new technologies to improve HM safety, and
- Ability to test emerging technologies and procedures for HM safety.

“The first step in winning the future is encouraging American innovation,” excerpted from President Obama’s 2011 State of the Union Address. The key word within his speech was “innovation.” He went on to address the importance of investing in basic research: “But because it’s not always profitable for companies to invest in basic research, throughout our history, our government has provided cutting-edge scientists and inventors with the support that they need.”

President Barack Obama



7.0 Research and Development

Project Topic and Selection Process

The selection of research topics is a collaborative process to address risks that are identified within OHMS. This R&D strategic plan establishes a process to ensure HM risks are addressed based on a collaborated OHMS approach.

7.1 Step 1: Review of Hazardous Materials Information and Risk

The initial step in R&D project development is to review data and supporting information related to the causes of potential safety hazards. The research will be prioritized to consider such factors as the number of fatalities and injuries, property damage, and transportation disruptions due to HM incidents. The requested research will show ROI and demonstrate its impact to address HM risks in the transportation system.

The analysis of historical HM incident data, investigations, and enforcement actions provides the R&D program an opportunity to prioritize research initiatives. As risks are more clearly identified, the constant analysis of data will drive the R&D program's formulation of future research budget requests.

The potential for emerging and future HM risks can be better understood by reviewing industry trends. The knowledge of how HM incidents occur and continuously keeping apprised of industry technological advances will allow OHMS to better position itself to identify potential risks. Internal and external data systems will be used to determine HM risks and highlight areas of interest to prioritize potential HM research. The in-depth examination of various data sets will provide a deeper understanding of circumstances and concerns necessary to address HM risks.



7.2 Step 2: Topics for Assignment under “Priorities”

The established priorities assist the Engineering and Research Division to effectively manage the research portfolio and identify specific R&D initiatives that will have a direct impact on the HM safety mission. Furthermore, these priorities will allow the ability to define scope for the use of limited resources.

Prioritizing the R&D program’s initiatives are essential for identifying critical needs. Potential solutions could result in new or revised regulations, improved HM industry standards and best practices, improved package design and performance, focused enforcement actions, outreach and training campaigns, or additional research initiatives.

As mentioned in Section 6, the research priorities are categorized as: Package Integrity, Human Factors, Analysis of Risks, Risk Management and Communication, and Emerging Technology Risk Mitigation.

In addition, there are four significant research initiatives currently identified as essential to minimizing and removing potential HM vulnerabilities. The four significant research initiatives are:

- Energetic HM Research,
- Hazardous Materials Automated Cargo Communication for Efficient and Safe Shipments (HM ACCESS), and
- Safety Risk Model.

The selection of research topics is a process that incorporates steps to address risks that are identified within OHMS. The R&D program examine various information, data and input from OHMS personnel. The R&D strategic plan establishes this performance-based process to ensure HM risks are addressed based on a uniform OHMS approach.

7.3 Step 3: Review Current and Past HM R&D Initiatives

Once research topics have been selected, the R&D Program will review current and potential R&D initiatives. The review will involve previous related industry and government efforts. In order to better manage resources and prevent R&D initiatives duplication(s), this strategic plan will establish a virtual OHMS Research and Development Library. The Engineering and Research’s R&D strategic plan requires the R&D Library to become effective in FY 2013.

7.4 Step 4: Development of Project Description

Research project descriptions will be prepared in a manner that communicates the issue, background, and potential costs regarding the research need. The supporting information such as additional studies, projects, and pertinent information will be included with the project description to support the proposed R&D initiative.

The structured descriptions of research projects are used to prioritize, select, and allocate funding. The project descriptions are expected to convey outcomes, project cost estimates and durations, and anticipated project results. The project description will be submitted in a format so that a fair assessment can be made by the R&D committee. The project description examples will be submitted on a standardize form to ensure consistency and uniformity.

The HM R&D committee will rate according to objective criteria, which reflects the expected contribution to HM safety and likelihood of success to minimize HM risk(s). It is important to note that a project description may cross over multiple priorities; as a result, the project(s) having overarching R&D priorities will be ranked higher than single priority projects.

7.5 Step 5: HM R&D Selection Committee and Rating of Projects

The selection of HM R&D will be based on the project description and supporting information. The goal is to select research initiatives available to obtain the best return on investment. To achieve this, an internal committee consisting of the R&D Chief and each OHMS's Division Director, or their delegate, will meet to determine the best research opportunities. The responsibility of this committee is to evaluate and rank R&D projects throughout each fiscal year. The process will provide the committee an opportunity to gather information regarding the status of projects granted the previous fiscal year. During the annual selection process, an evaluation will occur regarding on-going research initiatives that may require additional funding for the upcoming fiscal year, taking into consideration timeliness, budget constraints, and status updates. As these projects are awarded there will be a peer review process to ensure the likelihood that the proposed research can address the OHMS needs.

8.0 Significant Research and Development Initiatives

Significant research and development initiatives are efforts identified as having a particular important impact on the transportation system. The initiatives identified as having the greatest impact to the safety mission will be researched based on multiple priorities. For example, Lithium Battery Safety consists of multiple priorities that includes package integrity, technical analysis of risk, emerging technology risks and human factors; therefore, the research will be labeled as SIGNIFICANT research initiative.

Significant research initiatives are identified through sensitive issues that affect the immediate mission of the agency. These research initiatives are conducted based on risks that pose greatest harm to the public or present an immediate hazard within the transportation systems.

8.1 Energetic Hazardous Materials Research Initiative – Lithium Battery Safety

OHMS estimates that 3.3 billion lithium cells and batteries were transported worldwide in 2008. This represents an 83 percent increase since 2005. The estimated failure rate of all lithium batteries is in the range 1 failure per 10 million batteries manufactured. This figure is lower in transport environments. OHMS understands the positive safety record associated with the transportation of lithium batteries; however, a lithium battery incident via air mode would result in catastrophic consequences. Managing a low probability--high consequence risk poses a great challenge. There is no one solution because the causal factors are varied and risk reduction requires a diverse approach with the participation of a broad range of participants.



Lithium battery technology is complex and has several known risks. The expansion of lithium battery use in portable electronic and industrial applications introduces additional challenges. There is a general opinion among lithium battery manufacturers that the root cause of most lithium battery incidents is short circuiting. A short circuit can result in thermal runaway a situation characterized by excessive heat, exothermic side reactions, and combustion that begins at higher temperatures accelerating the thermal runaway. This condition can sometimes lead to rupture of sealed cells and resulting fire. Basic and applied research into the design of battery safety features, modernization of design testing protocols, and manufacturing quality assurance standards will provide critical information to address the safety of lithium battery transportation.

Currently, the transportation risks associated with various lithium battery types is being addressed through measured approaches including rulemaking, enforcement, and outreach. OHMS plans to conduct research that will examine lithium battery transportation and potentially update package performance and test criteria. This research is schedule to begin in FY 2012.

8.2 HM Automated Cargo Communications for Efficient and Safe Shipping (ACCESS) Initiative

HM shipping papers serve as a primary means for hazard communication—providing information to carriers, operators, emergency responders, and inspectors about the types and quantity of HM being transported. While numerous operational and technological advances have been incorporated into main stream business practices for industry and government, the current HM shipping paper system remains a paper-based system.

OHMS recognizes paper-based systems are cumbersome in comparison to the operational and technological solutions available today. Paper systems also can contribute to the risks associated with transporting HM that cannot be quickly remedied, and in turn can lead to:

- Increased storage time due to time delays associated with the physical transfer of the paper-based shipping paper;
- Mishandling of HM due to discrepancies in paperwork, or incorrect or missing information;
- Ineffective or inaccurate hazard communication to emergency responders during HM incidents due to the paper shipping paper being unavailable, discrepancies in paperwork, error, etc.; and
- Lack of access to the information contained in the shipping paper to verify the contents of the shipment due to the inability to approach the affected vehicle.

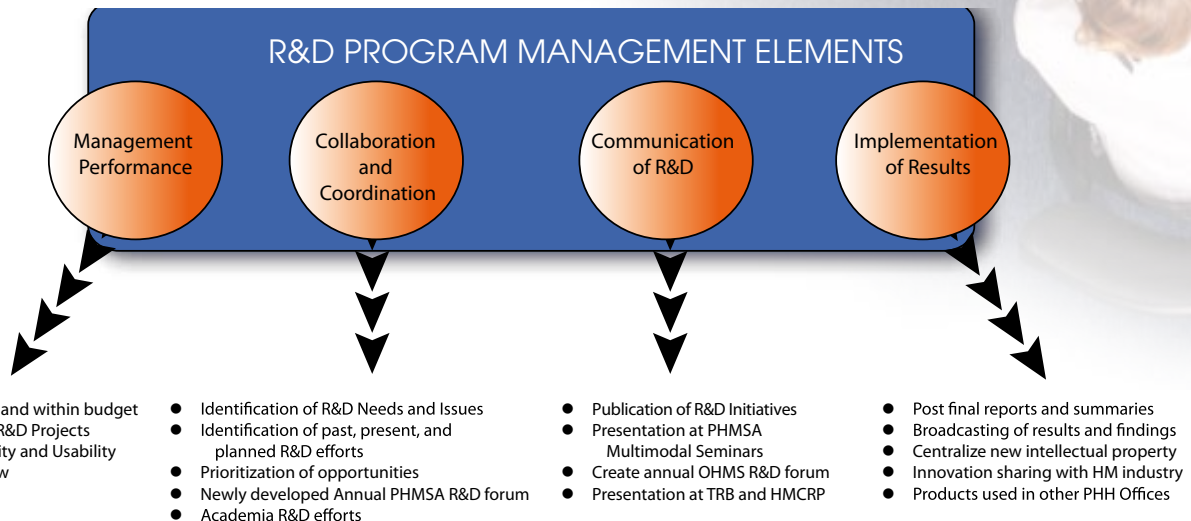
The purpose of HM-ACCESS initiative is to identify and eliminate barriers to the use of paperless hazard communications technologies.

The Engineering and Research Division is conducting this significant research initiative to quantify concepts to enhance HM communication through existing and nonexistent operational and technological methods. The findings of this research initiative will be used to support technologies to advance safety efforts in the transportation of HM. The Engineering and Research Division initiated this effort in FY 2011.


9.0 Business and Performance-Based Management

The R&D Program is designed to focus entirely on supporting the needs of PHMSA's HM safety mission. The Engineering and Research Division will take actions to manage the time of project delivery and ensure the research initiatives are within budget. Specific emphasis will be placed on the process of acquisition. As explained in Section 3, the consistent cycling process ensures entities and methods are relevant to address the safety risks identified in the transportation of HM. The research initiatives selected will be beneficial when implemented. The steps identified in Section 5.0 of this strategic plan ensure that projects selected have "immediate benefits," and also can be examined in a five- to ten-year period to determine if the effort has "long-term impacts" as identified in the program model.

The OHMS R&D Program incorporates management principles under four elements. They are: Management Performance, Internal and External Collaboration and Coordination, Communication of R&D and Implementation of Results.



9.1 MANAGEMENT PERFORMANCE



The guiding principle for management of the R&D program is enhancement of HM safety. The impact of the program is determined by measurement of performance against specific goals and performance metrics. A planned annual Engineering and Research R&D forum, along with an effort to incorporate a R&D dialogue into the Multimodal Seminars, will provide: 1. a joint government/industry opportunity, 2. mechanisms for gathering ideas, concepts, guidance, and 3. obtain knowledge from stakeholders as input for needed research to address risk(s).

In FY 2013, the Engineering and Research Division plans to conduct its first Hazardous Materials Safety Annual R&D forum that will bring together government agencies, research institutions, HM associations, standards organizations, and public representatives to begin identifying research needs and technologies for development. The outcome of the forum will allow the R&D program to focus on priorities listed in Section 6.0.

The Engineering and Research Division's R&D office will establish an internal HM R&D Selection Committee to assist in determining research priorities based immediate benefits and long-term impacts. As external stakeholders ability to identify specific needs, and as the R&D program continues to evolve, the Engineering and Research Division expects the program to become self sustaining.

To expedite R&D contracts in a competitive and merit-based process, build and organize R&D portolios, the Engineering and Research Division will gather research initiatives on a standardized form. The form will be reviewed by the HM R&D Selection Committee to determine the impact to the overall safety mission. The strategic plan outlines in Section 7 how reserach initiatives are selected and presented to ensure consistency and transparency.

Performance-Based Management

The Engineering and Research Division will manage the performance of the initiatives through the guidelines established within this strategic plan and acquisition process. During the time of completion of the competitive procurement process, each research initiative will be assigned to a certified Contracting Officer's Representative (COR) as required by the Federal Acquisition Regulations.

Specific performance goals have been developed and described in this R&D strategic plan to measure the performance of the initiative. The R&D Program Model, in Section 5, is developed to allow each project to demonstrate its principal action, products, external communications, and immediate benefits and the long-term impacts to minimize risks and improve HM safety. To effectively manage performance, the four measures will be used to gauge the research initiatives:

- Timeliness and Within Budget
- Quality of Projects
- Functionality and Usability
- Peer Review

9.2 Internal and External Collaboration

The Engineering and Research Division's R&D Office recognizes that other organizations, including government agencies, non-government research organizations, colleges and universities, and the HM industry can contribute to the achievement of minimizing HM risks through their knowledge and efforts. The R&D Office plans to increase the awareness of closely-related programs to enhance safety goals through research synergies. Collaboration can avoid unnecessary and wasteful duplication of research efforts.

To further improve collaboration efforts, the Engineering and Research Division established OHMS Research and Development web page. The modification took place early FY 2012, and will include information regarding this strategic plan, the goals of the program, and upcoming forums on R&D efforts. The modification of the website allows external stakeholders to identify research priorities of importance. It is imperative that these efforts take place by the end of FY 2012 because internal identification of research priorities may not have a direct impact on the needs of the HM community or address potential risks experienced by external stakeholders. Five management benchmarks will be implemented within the five-year period of this strategic plan to ensure effective collaboration:

- Identification of R&D needs and issues through OHMS's updated R&D webpage,
- Identification of past, present, and planned R&D projects,
- Prioritization of technology opportunities and R&D needs,
- Annual PHMSA R&D Technology Symposium, and
- Academia R&D effort.

9.3 Communication of R&D Program Priorities, Results, and Impacts

The Engineering and Research Division will communicate impacts the R&D program's descriptions, project actions, immediate benefits, and long-term impacts. The Engineering and Research Division's R&D office created a research portfolio to communicate the results of projects, project descriptions, and technical reports. The HM R&D electronic portfolio will be in place by FY 2017. Five benchmarks are incorporated within this strategic plan to ensure effective communication:

- Publication of R&D project actions, results, and impacts to stakeholders through newly updated R&D website,
- Presentation at Multimodal Seminars,
- Creation of the annual Engineering and Research R&D forum,
- Attendance at the Transportation Research Board (TRB) and Hazardous Materials Cooperative Research Program (HMCRP) Annual Meetings, and
- Implementation of the Electronic R&D portfolio.

9.4 Implementation of Results

The completion of an R&D initiative is the initial step in finding the resolution to an HM safety issue. Consistent with a scientific method, there is the hypothesis, gathering of data, testing, obtaining results, but most importantly are the conclusions. The Engineering and Research Division will openly communicate the findings, and demonstrate the tangible results through various aspects of the OHMS programs. The five steps within the R&D program's strategic plan to ensure there are ROIs:

- Post final reports and summaries of projects on R&D website,
- Publically broadcast results and findings,
- Promote OHMS results,
- Share innovative technology with HM industry, and
- Use products in support of OHMS's Program offices.

Endnotes:

- ¹ Bureau of Commerce, Bureau of Transportation Statistics Commodity Flow Survey 2002, 2007 .
- ² Top Consequences Hazardous Material Commodities, PHMSA, February 2011.
- ³ Ibid.
- ⁴ Hazardous Materials Transportation Uniform Safety Act of 1990 (Pub. Law 101-615), Sec. 25. Improvements to Hazardous Materials Identification Systems, November 16, 1990 (104 Stat. 3244).
- ⁵ Transportation Research Board National Research Council. Hazardous Materials Shipment Information for Emergency Response, Special Report 239. National Academy Press. (Washington, D.C. 1993) p. 2.

Office of Hazardous Materials Safety Research and Development

Submit your request for information to the following address:

Pipeline and Hazardous Materials Safety Administration

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