

***Federal Funding Opportunity
Request for Applications (RFA)***

Executive Summary

Federal Agency Name: U.S. Department of Transportation
Federal Highway Administration
Office of Acquisition Management
1200 New Jersey Avenue, SE
Washington, DC 20590
Attn: Carl Rodriguez, HAAM-20F

Funding Opportunity Title: **“Support of Highway Research, Development and Deployment Activities.”**

Announcement Type: This is the initial announcement of this funding opportunity.

Funding Opportunity Number: ***RFA Number DTFH61-12-RA-00006***

Catalog of Federal Domestic Assistance (CFDA) Number: 20.200

Dates: RFA Issue Date is December 16, 2011
Application Due Date is December 29, 2011

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TABLE OF CONTENTS

| <u>Section Title</u> | <u>Page</u> |
|---|-------------|
| SECTION I - FUNDING OPPORTUNITY DESCRIPTION | 3 |
| SECTION II - AWARD INFORMATION | 8 |
| SECTION III - ELIGIBILITY INFORMATION | 9 |
| SECTION IV - APPLICATION AND SUBMISSION INFORMATION | 9 |
| SECTION V - APPLICATION REVIEW INFORMATION | 12 |
| SECTION VI - AWARD ADMINISTRATION INFORMATION | 13 |
| SECTION VII - AGENCY CONTACT | 25 |
| Attachment A. Memorandum of Cooperation dated July 13, 2011 (4 pages) | |
| Attachment B. MIRIAM Project Plan (32 pages) | |

SECTION I – FUNDING OPPORTUNITY DESCRIPTION

A. STATEMENT OF PURPOSE

The purpose of establishing a cooperative agreement between the Federal Highway Administration (Government) and the Forum of European National Highway Research Laboratories (FEHRL) (Recipient) is to support the Memorandum of Cooperation between these two entities as authorized by 23 U.S.C. Section 506, support research activities, undertake international outreach activities, and inform the United States highway community of technological innovations in foreign countries that could significantly improve highway transportation in the United States.

B. LEGISLATIVE AUTHORITY

The legislative authority to conduct this effort is derived from 23 USC Section 506, Surface Transportation Research, which states the following:

a) Establishment. - The Secretary may establish an international highway transportation outreach program -

(1) to inform the United States highway community of technological innovations in foreign countries that could significantly improve highway transportation in the United States;

(2) to promote United States highway transportation expertise, goods, and services in foreign countries; and

(3) to increase transfers of United States highway transportation technology to foreign countries.

(b) Activities. - Activities carried out under the program may include -

(1) the development, monitoring, assessment, and dissemination in the United States of information about highway transportation innovations in foreign countries that could significantly improve highway transportation in the United States;

(2) research, development, demonstration, training, and other forms of technology transfer and exchange;

(3) the provision to foreign countries, through participation in trade shows, seminars, expositions, and other similar activities, of information relating to the technical quality of United States highway transportation goods and services;

(4) the offering of technical services of the Federal Highway Administration that cannot be readily obtained from private sector firms in the United States for incorporation into the proposals of those firms undertaking highway transportation projects outside the United States, if the costs of the technical services will be recovered under the terms of the project;

(5) the conduct of studies to assess the need for, or

feasibility of, highway transportation improvements in foreign countries; and

(6) the gathering and dissemination of information on foreign transportation markets and industries.

(c) Cooperation. - The Secretary may carry out this section in cooperation with any appropriate -

- (1) Federal, State, or local agency;
- (2) authority, association, institution, or organization;
- (3) for-profit or nonprofit corporation;
- (4) national or international entity;
- (5) foreign country; or
- (6) person.

Statutory Authority to award a cooperative agreement is also derived from 23 USC 502 (b)(3) as amended by P.L. 109-59 – August 10, 2005. Per Section 5201 paragraph (c)(3) COOPERATION, GRANTS AND CONTRACTS.- “The Secretary may carry out research, development, and technology transfer activities related to transportation- ... (C) by making grants to, and entering into contracts and cooperative agreements with one or more of the following: the National Academy of Sciences, the American Association of State Highway and Transportation Officials, any Federal laboratory, Federal agency, State agency, authority, association, institution, for-profit, or non-profit corporation, organization, foreign country, or any other person.”

A sole source justification was completed for this effort. The basis for non-competing this requirement is found in FHWA Order 4410.1 Section 11 (b)(4) entitled “Capabilities,” which allows for award without competition if, “The applicant demonstrates a unique capability to perform the activity successfully, based upon unique equipment, proprietary data, technical expertise, location or other such unique qualifications.”

C. BACKGROUND

The Government entered into a Memorandum of Cooperation (MOC) (reference Attachment A) with FEHRL on July 13, 2011 to establish a common and transparent coordination and communication platform to leverage experience and expertise to address current and future highway transportation system research and technology needs. The MOC’s purpose is to more formally establish cooperative partnerships to leverage resources between the Government’s research, development and technology programs and initiatives pursued by FEHRL and its partner agencies.

To ensure the MOC’s effective and efficient implementation, two separate mechanisms will be established between the Government and FEHRL to outline overarching and administrative protocols to be followed. The first is for the Government to receive funding from FEHRL to apply towards projects where the Government is the lead and will assume primary project leadership responsibilities. The second is a cooperative agreement with FEHRL for projects that fill gaps or advance the Government’s research objectives as determined through assessments of its strategic goals and risk management processes

D. OBJECTIVE

The objective of this cooperative agreement is to collaborate with the Recipient in order to conduct research to seek innovative solutions to meet shared challenges. The Recipient has access to and strong ties with many different national institutes with programs for research, development or deployment of technology, and innovation activities. This collaboration will be affected through work plans for multiple focus areas as listed in the scope of the Cooperative Agreement below.

Scope of the Cooperative Arrangement

The scope of this Cooperative Agreement includes the following activities:

Develop and carry out a research program consisting of work plans for research, development or deployment of technology and innovation activities from among the following highway transport areas: planning, environment, right of way, asset management, materials, structures, hydraulics, traffic operations, traffic impacts, road user behavior, economics, safety, and policy. These research areas are expected to accomplish the following objectives:

- To reduce the number of fatalities attributable to infrastructure design characteristics and work zones;
- To improve the safety and security of highway infrastructure;
- To improve the management of infrastructure assets and advance the implementation of a performance-based program;
- To improve the ability of transportation agencies to deliver projects that meet expectations for timeliness, quality and cost;
- To reduce user delay attributable to infrastructure system performance, maintenance, rehabilitation and construction; and
- To improve highway condition and performance through increased use of design, materials, construction, and maintenance innovations.
- To reduce the lifecycle environmental impacts of highway infrastructure through innovations in design, construction, operation, preservation, and maintenance;
- To study vulnerabilities of the transportation system to seismic activities and extreme events and methods to reduce those vulnerabilities;
- To strengthen transportation planning and environmental decision-making to minimize the impact of surface transportation on the quality of life;
- To improve freight movement and increase productivity;
- To assess policy and system financing alternatives; and
- To determine emerging issues in the domestic and international transportation community from a policy perspective.

E. STATEMENT OF WORK

The recipient will furnish the necessary facilities, materials and personnel to conduct research as described in individual work plans (in compliance with the above listed objective) to be issued under the Cooperative Agreement. During the period of the Agreement the Government and Recipient will meet periodically, at a minimum on an annual basis, to review and discuss projects in support of the Agreement. Projects will be those of mutual interest to both the Government and the Recipient. In addition to the Government funds provided, the Recipient shall contribute toward the total cost of each work plan based on the legislative authority of the FHWA program under which a particular work plan is funded. The amount of cost share will be determined for each individual work plan. The amount of cost share shall be a minimum of 0 percent but no more than 50 percent of the total cost of any individual work plan. These projects shall be initiated in the format of work plans described below. The final work plan will be the preparation of a comprehensive report of the activities conducted under the Agreement.

Work Plan Procedures

Performance under this Cooperative Agreement will be effected using individual Work Plans in accordance with the following three step procedure:

Step One –Issuance of Work Plan Proposal Request

Based upon topics discussed with the Recipient, the Agreement Officer or the Agreement Officer's Technical Representative will issue Work Plan proposal requests to the Recipient. Each Work Plan proposal request shall contain at a minimum the following information:

- (a) Project Title/ Research Area;
- (b) Project/Strategic Linkages (this will include the FHWA program name and a brief description of the specific aspect(s) this effort will support. In addition, this section will provide the Recipient's research project name);
- (c) Purpose/Goal of the Recipient's Project;
- (d) Mechanisms of Collaboration- Identify the expected means to effect collaboration with the Recipient, (e.g., detail assignments, exchange of reports or study results, technical workshops, access to facilities, inviting participant to use TFHRC facilities, etc.);
- (e) Period of Performance- (Anticipated start and end dates as well as key milestones);
- (f) Anticipated Products /Results;
- (g) Dollar amount of Government funding available;
- (h) The amount of cost share required as a percentage of the total estimated cost of the Work Plan.

Step Two- Submission of Work Plan Proposal

In response to the Government's Work Plan proposal request, the Recipient will provide a Work Plan proposal. The Recipient's Work Plan proposal will be submitted to the Government. The proposal shall at a minimum include:

- (a) Title of Work;
- (b) Description of the project with a complete technical plan and budget. The technical plan will describe the specific activity to be undertaken, its objectives, measurements to be made, timeframes, evaluations, and interim and final reporting requirements. For each year of the proposed Work Plan the budget will contain, the proposed dollar cost by cost element for the Government's share and for the Recipient's share;
- (c) Proposed deliverable schedule.

Step Three- Work Plan Issuance

The Government will issue the written Work Plan which will incorporate the specific agreement of the parties. Each Work Plan will specify the type and amount of assistance to be provided by the Government, and the work and goals to be accomplished by Recipient. In addition to the above, each Work Plan document will also at a minimum include the following:

- (a) Research Plan number;
- (b) Title of Work;
- (c) Total Cost in dollars of the Work Plan including the Federal share and the Recipient share;
- (d) Funding information;
- (e) Description of the project with a work plan and budget;
- (f) Completion date for the work plan;
- (g) Work Plan deliverable schedule;
- (g) Name, mailing address, e-mail address, and business telephone number of the Recipient's Principal Investigator;
- (f) Signatures of the authorized representatives of the Government and the Recipient indicating assignment and acceptance of the project undertaking.

No work shall commence without Agreement Officer's written approval of the Work Plan.

The agreed upon Work Plans shall be incorporated into the overall Cooperative Agreement by a bilaterally signed amendment.

ALLOWABLE PERIOD OF WORK PLAN ISSUANCE

All work and services required shall be completed on or before the date specified in the individual Work Plans. Work Plans may be issued up to the final day of this agreement, and the agreement will remain in force to allow for completion of all Work Plans issued. However, no new Work Plans shall be issued after the final day of the agreement. Performance shall begin on the effective date of the agreement.

Section 508

While the requirements of Section 508 of the Rehabilitation Act do not apply to assistance Agreements, the FHWA is subject to the Act's requirements that all documents posted on an FHWA or FHWA-hosted website comply with the accessibility standards of the Act. As such, all electronic and information technology products that are submitted under this cooperative agreement must be Section 508-compliant so that they can be posted without further modification.

All final deliverable electronic documents prepared under this agreement must meet the requirements of Section 508 of the Rehabilitation Act of 1973, as amended. The act requires that all electronic products prepared for the Federal Government be accessible to persons with disabilities, including those with vision, hearing, cognitive, and mobility impairments. View [Section 508 of the Rehabilitation Act \(http://www.access-board.gov/508/508standards.htm - PART 1194\)](http://www.access-board.gov/508/508standards.htm) and the [Federal IT Accessibility Initiative Home Page \(http://section508.gov\)](http://section508.gov) for detailed information. The following paragraphs summarize the requirements for preparing FHWA reports in conformance with Section 508 for eventual posting by FHWA to an FHWA-sponsored website.

- a. Electronic documents with images
Provide a text equivalent for every non-text element (including photographs, charts and equations) in all publications prepared in electronic format. Use descriptions such as "alt" and "longdesc" for all non-text images or place them in element content. For all documents prepared, vendors must prepare one standard HTML format as described in this statement of work AND one text format that includes descriptions for all non-text images. "Text equivalent" means text sufficient to reasonably describe the image. Images that are merely decorative require only a very brief "text equivalent" description. However, images that convey information that is important to the content of the report require text sufficient to reasonably describe that image and its purpose within the context of the report.
- b. Electronic documents with complex charts or data tables
When preparing tables that are heavily designed, prepare adequate alternate information so that assistive technologies can read them out. Identify row and column headers for data tables. Provide the information in a non-linear form. Markups shall be used to associate data cells and header cells for data tables that have two or more logical levels of row and column headers.
- c. Electronic documents with forms
When electronic forms are designed to be completed on-line, the form shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.

SECTION II – AWARD INFORMATION

A. FUNDING

FHWA anticipates Federal funding up to the amount of \$2,000,000.00 will be made available for this award subject to availability. The Recipient shall contribute toward the total cost of each Work Plan based on the legislative authority of the FHWA program under which a particular Work Plan is funded. The amount of cost share will be determined for each individual Work Plan. The amount of cost share shall be a minimum of 0 percent but no more than 50 percent of the total cost of any individual Work Plan.

B. NUMBER OF AWARDS ANTICIPATED

FHWA anticipates making one award resulting from this RFA.

C. PERIOD OF PERFORMANCE

The period of performance for this cooperative agreement will be 60 months, commencing from the effective date of this agreement.

D. TYPE OF AWARD

FHWA intends to award one cooperative agreement as a result of this RFA.

E. DEGREE OF FEDERAL INVOLVEMENT

FHWA anticipates substantial Federal involvement between FHWA and the Recipient during the course of this project. FHWA anticipates the Federal involvement will include:

- Technical assistance and guidance;
- Close monitoring during performance;
- Involvement in technical decisions; and
- Participation in status meetings including kickoff meeting.

The FHWA will partner with the Recipient and provide the necessary guidance to help complete all work under the agreement. The AOTR will participate in the planning and management of this cooperative agreement and will coordinate activities between the Recipient and the FHWA.

SECTION III - ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS

Competition under this RFA is restricted to the Forum of European National Highway Research Laboratories (FEHRL).

B. COST SHARING OR MATCHING

The Recipient shall provide a matching contribution to the total cost of the cooperative agreement. The Recipient shall contribute toward the total cost of each Work Plan based on the legislative authority of the FHWA program under which a particular work plan is funded. The amount of cost share will be determined for each individual work plan. The amount of cost share shall be a minimum of 0% but no more than 50% of the total cost of any individual Work Plan.

Note: See Section IV for documentation necessary to support proposed cost-share.

SECTION IV – APPLICATION AND SUBMISSION INFORMATION

Note: Instructions set forth in this section pertain solely to the MIRIAM work plan.

A. APPLICATION FORMS

Applicant shall complete all forms included in the Application Package for this RFA as contained in www.grants.gov. The Applicant shall submit the Application Package online at www.grants.gov.

Note: It is recommended that applicants register on grants.gov in advance of the application due date. Approval of user registrations for the grants.gov site may take multiple weeks.

B. CONTENT AND FORM OF APPLICATION SUBMISSION

The Application Package shall consist of the following:

- SF 424 (“Support of Highway Research, Development and Deployment Activities”)
- SF 424A (For the MIRIAM Project)
- SF 424B
- SF LLL
- Grants.gov Lobbying Form
- Attachments Form*

1. Technical Application For the MIRIAM Project – 25 page limit
2. Budget Application For the MIRIAM Project – no page limit

*Applicants may attach as many files as necessary to provide information requested below.

Submit your application in the following format:

Part I – Technical Application

NOTE: The Technical Application for the Miriam work plan cannot exceed 25 pages.

In the event an application exceeds the 25-page limitation, the Government will evaluate only the first 25 pages of the application. The format of the above application shall be as follows:

1. Applications shall be prepared on 8 ½ x 11 inch paper except for foldouts used for charts, tables, or figures, which shall not exceed 11 x 17 inches. Foldouts shall not be used for text, and shall count as two pages.
2. A page is defined as one side of an 8 ½ x 11 inch paper. Therefore, a piece of paper with printing on both sides is considered two pages.
3. Text shall be printed using a font size no less than 12 cpi.
4. Page margins shall be a minimum of 1 inch top, bottom and each side.

Technical application must contain:

TECHNICAL APPROACH & MANAGEMENT APPROACH FOR THE MIRIAM WORK PLAN

The application shall include a program narrative statement that describes the technical approach for a work plan for MIRIAM as described below. Describe in detail how you would proceed if awarded this cooperative agreement and how you propose to meet the program objectives.

(a) Project Title/ Research Area;

“Models for Rolling Resistance in Road infrastructure Asset Management Systems (MIRIAM)”

(b) Project/Strategic Linkages (this will include the FHWA program name and a brief description of the specific aspect(s) this effort will support. In addition, this section will provide the Recipient’s research project name);

For FHWA, this project aligns with the strategic objective for the Nation’s highway system to provide for safe, reliable, effective, and sustainable mobility for all users. This initiative will assist us in implementing a National Infrastructure Health Index to assess the State of Good Repair on corridors of national significance. In order to accomplish this, this project will help us to collect, analyze, and interpret key information to establish performance standards, identify critical performance gaps, and document system performance and needs.

MIRIAM, being conducted by the Danish Road Directorate, Danish Road Institute will support the goal of optimizing pavement quality and condition in relation to CO₂-emission and energy consumption.

(c) Purpose/Goal of the Recipient's Project;

The MIRIAM project consists of four activities:

1. Rolling Resistance data compilation and modeling
2. Impacts of lower Rolling Resistance
3. Implementation
4. Training and Dissemination

(d) Mechanisms of Collaboration- Identify the expected means to effect collaboration with the Recipient, (e.g., detail assignments, exchange of reports or study results, technical workshops, access to facilities, inviting participant to use TFHRC facilities, etc.);

Funding in the amount of \$100,000 is being provided to FEHRL for this project. The FHWA's interests in collaboration on this project include three primary areas identified in the MIRIAM project plan Attachment B.:

- Sub-project 5.2 Investigate Influence of Pavements Characteristics on Energy Efficiency
- Sub-project 5.3 Investigate the Importance of Rolling Resistance on the Efficiency within Life Cycle Analysis Framework
- Sub-project 5.4 Constraints/Requirements to Implementation
 - Work Item 5.4.3 Guideline for Implementation of Rolling Resistance in Asset Management Systems

(e) Period of Performance- (Anticipated start and end dates as well as key milestones);

The anticipated start date is January 20, 2012. The anticipated end date is January 19, 2015

The MIRIAM research project began in 2010 and will continue through 2014. A report on "Energy saving potentials in road characteristics" is expected Dec. 31, 2011.

Jan. 2012: TRB Annual Meeting Session on "Greening Pavements: Reducing CO2 Emissions through Reduced Rolling Resistance - Measuring and Modeling."

CY 2012-2014 Exchange of information on additional phases of research and implementation strategies.

(f) Anticipated Products /Results;

The proposed outcome of this project is: A strategic tool for decision makers for setting up and achieving energy-saving and CO2-reducing goals.

(g) Dollar amount of Government funding available;

Funding in the amount of \$100,000 will be made available for this project.

(h) The amount of cost share required as a percentage of the total estimated cost of the Work Plan;

The amount of cost share required is 50 percent of the total cost of this project.

STAFFING APPROACH FOR THE MIRIAM WORK PLAN

Provide a program organizational chart identifying proposed staff members assigned to the project. Include the title and a brief description of each position's responsibilities, as well as the proposed level of effort and allocation of time for each position.

Provide brief resumes for the proposed Principal Investigator, Program Manager and key personnel to include name, experience, education, and proposed role in project. (Note: resumes do count against the designated page limitations.)

Part II- Budget Application For The MIRIAM Work Plan

NOTE: There is no page limit on budget application for the Miriam Work Plan.

Budget application must contain:

1. Detailed spreadsheets and supporting information clearly delineating which costs are covered by Federal Funds and which costs are proposed cost share and supporting all estimated costs by year for the entire 36 month period of performance.
 - Provide labor categories, labor hours or percentage of time, labor rates.
 - Provide indirect rates and bases, include any audit information to support rates.
 - Provide supporting information to justify estimates for Other Direct Costs such as equipment, travel, etc.

Note: Travel will be reimbursed at cost in accordance with the Federal Travel Regulations in effect at the time of travel.
2. If sub-recipients (lower-tiered organizations and/or individual consultants) will be used in carrying out this project, the following minimum information concerning such, should be furnished:
 - Name and address of the organization or consultant.
 - Description of the portion of work to be conducted by the organization or consultant.
 - Cost details for that portion of work.
 - Letter of commitment from sub-recipient.
3. The use of a Dun and Bradstreet (D&B) Data Universal Numbering System

(DUNS) number is required on all applications for Federal grants or cooperative agreements. Please provide your organization's DUNS number in your budget application.

4. A statement to indicate whether your organization has previously completed an A-133 Single Audit and, if so, the date the last audit was completed. (For further information see http://www.whitehouse.gov/sites/default/files/omb/assets/a133/a133_revised_2007.pdf)
5. A statement to indicate whether your organization has an approved accounting system and the internal controls in accordance with 49 CFR Part 19 "Uniform Administrative Requirements for Grants and Agreements with Institutions of Higher Education, Hospitals, and other Non-profit Organizations."

C. SUBMISSION DATES AND TIMES

Applications must be received electronically through www.Grants.gov by 4:00 pm EST on December 29, 2011.

The deadline cited herein is the date and time by which the agency must receive the application.

D. OTHER SUBMISSION REQUIREMENTS

FHWA uses www.Grants.gov for receipt of all applications. Applicants must register with www.Grants.gov and use the system to submit application electronically.

In the event of system problems or technical difficulties with the application submittal, applicants should contact the FHWA point of contact designated on page 1. If applicants are unable to use the www.Grants.gov system due to technical difficulties, applicants must e-mail applications to the FHWA point of contact listed on page 1 no later than the application deadline cited above.

E. FUNDING RESTRICTIONS

FHWA will not provide any reimbursement of pre-award costs under this proposed agreement.

SECTION V – APPLICATION REVIEW INFORMATION

A. EVALUATION CRITERIA

The technical application will be evaluated based on the following criteria :

Technical Approach

The technical application will be evaluated based on the following criteria which are of equal importance:

1. The application demonstrates an understanding of MIRIAM's scope and tasks of the work plan.
2. The application demonstrates that the FEHRL organization has access to the staff that possesses the technical skills, qualifications, and experience to coordinate with FHWA on the MIRIAM work plan.

Cost

In addition to the criteria listed above, relative cost will be considered in the ultimate award decision. The budget application will be analyzed to assess cost reasonableness and conformance to applicable principles.

B. REVIEW AND SELECTION PROCESS

The Agreement Officer is the official responsible for final award selections.

The Government is not obligated to make any award as a result of this announcement.

C. ANTICIPATED ANNOUNCEMENT AND AWARD DATES

FHWA anticipates making award on or about January 20, 2012.

D. AWARD NOTICES

Only the Agreement Officer can commit the Government. The award document, signed by the Agreement Officer, is the authorizing document.

Notice that an organization has been selected as a Recipient does not constitute approval of the application as submitted. Before the actual award, FHWA will enter into negotiations concerning such items as program components, staffing and funding levels, and administrative systems. If the negotiations do not result in an acceptable submittal, the FHWA reserves the right to terminate the negotiation and decline to fund the applicant.

SECTION VI – AWARD ADMINISTRATION INFORMATION

A. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

1. GOVERNING REGULATIONS

Performance under this cooperative agreement shall be governed by and in compliance with the following requirements as applicable to the type of organization of the Recipient and any applicable subrecipients:

- 49 CFR 19 “Uniform Administrative Requirements for Grants and Agreements with Institutions of Higher Education, Hospitals, and other Non-profit Organizations”, [*located at: <http://www.dot.gov/ost/m60/grant/49cfr19.htm>*];
- 2 CFR Part 230 (OMB Circular A-122), “Cost Principles for Non-Profit Institutions” [*located at: http://www.whitehouse.gov/sites/default/files/omb/assets/omb/fedreg/2005/083105_a122.pdf*];
- OMB Circular A-133, “Audit of States, Local Governments, and Non-Profits” [*http://www.whitehouse.gov/omb/circulars_a133_compliance_09toc/*];
- 2 CFR Part 215 (OMB Circular A-110), “Uniform Administrative Requirements for Grants and Agreements With Institutions of Higher Education, Hospitals, and Other Non-Profit Organizations” [*located at: <http://www.whitehouse.gov/omb/circulars/a110/a110.html>*]; and
- Any other applicable Federal regulation or statute.

2. RESPONSIBILITIES OF THE RECIPIENT

The Recipient shall provide overall program management. Specifically, the Recipient shall be responsible for the following, as a minimum:

- Performing the Statement of Work as described in Section I, Funding Opportunity Description.
- Coordinating and managing work, including issuing and managing subcontracts/sub awards and consulting arrangements, as necessary.
- Submitting all required reports including Quarterly Progress Reports and Annual Budget Reviews. (See Paragraph B of this Section, entitled Reporting.)
- Meeting with the FHWA Agreement Officer’s Technical Representative (AOTR) as necessary.
- Participating in a kick-off meeting with the AO and/or the AOTR to discuss agreement expectations and procedures.
- Participating in Annual Budget Review meetings with the AO and/or AOTR.

3. TRAVEL AND PER DIEM

Travel and per diem authorized under this cooperative agreement shall be reimbursed in accordance with the travel costs section of 2 CFR Part 230 (OMB Circular A-122), "Cost Principles for Non-Profit Institutions." Per the Circular, in the absence of an acceptable, written institution policy regarding travel costs, the rates and amounts established in the Federal Travel Regulations in effect at the time of travel shall apply. In addition, all non-domestic travel shall be approved by the AO prior to incurring costs. Travel requirements under this grant agreement shall be met using the most economical form of transportation available. If economy class transportation is not available, the request for payment vouchers must be submitted with justification for use of higher class travel indicating dates, times, and flight numbers.

4. AMENDMENTS

Amendments to this cooperative agreement may only be made in writing, signed by both parties for bilateral actions and by the AO for unilateral actions, and specifically referred to as an amendment to this cooperative agreement.

5. AGREEMENT OFFICER'S TECHNICAL REPRESENTATIVE (AOTR)

The AO has designated _____ as Technical Representative to assist in monitoring the work under this agreement. The AOTR will oversee the technical administration of this agreement and act as technical liaison with the performing organization. The AOTR is not authorized to change the scope of work or specifications as stated in the agreement, to make any commitments or otherwise obligate the Government or authorize any changes which affect the agreement funding, delivery schedule, period of performance or other terms or conditions.

The AO is the only individual who can legally commit or obligate the Government for the expenditure of public funds. The technical administration of this agreement shall not be construed to authorize the revision of the terms and conditions of performance. The Agreement Officer shall authorize any such revision in writing.

6. OBLIGATION CEILING RATIO

Pursuant to section 1102 of Public Law 109-59 (SAFETEA-LU), the FHWA is required to annually redistribute a portion of allocated program authorization. Funds available for subsequent years of this agreement shall be adjusted for each fiscal year, which may increase or decrease the total estimated funding available.

7. INDIRECT COSTS

Indirect costs are allowable under this agreement as follows:

| <i>Indirect Rate Type</i> | <i>Rate (%)</i> | <i>Base</i> |
|---|-----------------|-------------|
| <i>(Information to be filled in at award)</i> | | |
| | | |
| | | |

In the event the recipient determines the need to adjust the above listed rates, the Recipient shall notify the FHWA of the planned adjustment and provide rationale for such adjustment. In the event such adjustment rates have not been audited by a Federal agency, the adjustment of rates must be pre-approved in writing by the Agreement Officer.

This Indirect Cost provision does not operate to waive the limitations on Federal funding provided in this document. The Recipient’s audited final indirect costs are allowable only insofar as they do not cause the Recipient to exceed the total obligated funding.

8. DATA RIGHTS

The Recipient shall make available to the Government copies of all work developed in performance with this cooperative agreement, including but not limited to software and data. The Government and others acting on its behalf shall have unlimited rights to obtain, reproduce, publish or otherwise use the data developed in the performance of this agreement pursuant to 49 CFR Part 19.36.

9. PAYMENT

The Recipient may request advances or reimbursement of costs incurred in the performance hereof as are allowable under the applicable cost provisions [see 49 CFR Part 19.25 (c)(6) and 2 CFR Part 215] not-to-exceed the funds currently available as stated herein.

Payment for Reimbursement: When requesting reimbursement of costs incurred, the Recipient shall submit supporting cost detail with the SF 270 to clearly document costs incurred. Cost detail includes a breakout of all costs incurred including, direct labor, indirect costs, other direct costs, cost share, travel, etc.

The Agreement Specialist and the AO reserve the right to withhold processing requests for advance or reimbursement until sufficient detail is received. In addition, reimbursement will not be made without AOTR review and approval to ensure that progress on the Agreement is sufficient to substantiate payment. After AOTR approval, the Agreement Specialist will certify and forward the advance or request for reimbursement to the payment office.

The Recipient shall submit an original and one copy of the SF 270 to one of the methods identified below:

1. Requests for advance or reimbursement via regular U.S Postal service mail:

Federal Highway Administration
P.O. Box 268865
Oklahoma City OK 73126-8865

2. Requests for reimbursement submitted via an overnight service should use the following physical address:

MMAC
FHWA/AMZ-150
6500 S. MacArthur Blvd
Oklahoma City, OK 73169
Attention: Carl Rodriguez , HAAM-20F
On-site contact: April Grisham, 405-954-8269

3. Alternatively, you may submit request for reimbursement to the following central e-mail address at 9-AMC-AMZ-FHWA-Invoices@faa.gov.

4. If you choose to submit your invoices to the central e-mail address, you must:

- (a) Include the invoice as an attached PDF document.

- (b) Include in the e-mail subject line the following:

- (i) "Invoice No. #

- (ii) Contract/Agreement Number

- (iii) Name of your Company/Organization."

Example: Invoice No. 35 – DTFH61-12-H-000XX – ABC Company

- (iv) Attention: Carl Rodriguez

All invoices must identify Carl Rodriguez *as the invoicing point of contact.*

Requests for reimbursement submitted to addresses other than those identified above will be returned to the recipient as non-conforming.

Note: Standard Forms may be located at <http://fhwa.dot.gov/aaa/hamhome.htm>.

10. **ACKNOWLEDGEMENT OF SUPPORT AND DISCLAIMER**

An acknowledgment of FHWA support and a disclaimer must appear in any publication of any material, whether copyrighted or not, based on or developed under the agreement, in the following terms:

"This material is based upon work supported by the Federal Highway Administration under Agreement No. DTFH61-12-H-000XX (to be filled in at award)."

All materials must also contain the following:

“Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the Author(s) and do not necessarily reflect the view of the Federal Highway Administration.”

11. SITE VISITS

The Federal Government, through its authorized representatives, has the right, at all reasonable times, to make site visits to review project accomplishments and management control systems and to provide such technical assistance as may be required. If any site visit is made by the Federal Government on the premises of the Performing Organization or a subrecipient under this agreement, the Performing Organization shall provide and shall require their subrecipients to provide all reasonable facilities and assistance for the safety and convenience of the Government representative in the performance of their duties. All site visits and evaluations shall be performed in such a manner as will not unduly delay work.

12. TERMINATION AND SUSPENSION

The Government may terminate this agreement in whole or in part, upon providing written notification to the Recipient, if the AO determines that a Recipient has failed to complete the technical or administration terms and conditions of the award.

13. BUDGET REVISION/REALLOCATION OF AMOUNTS

The Recipient is required to report deviations from budget and program plans, and request prior approval for budget and program plan revisions in accordance with 49 CFR Part 19.25.

Note: The Recipient must obtain prior written approval from the Agreement Officer to transfer amounts budgeted for direct cost categories when the cumulative value of such transfers will exceed 10% of the value of Federal share of this agreement. When requesting such approval, a letter request suffices.

14. FINANCIAL MANAGEMENT SYSTEM

By signing this agreement, the Recipient verifies that it has, or will implement, a financial management system adequate for monitoring the accumulation of costs and that it complies with the financial management system requirements of 49 CFR Part 19. The Recipient's failure to comply with these requirements may result in agreement termination.

15. ALLOWABILITY OF COSTS

Allowable costs will be determined in accordance with the applicable Federal cost principles, e.g., Non-Profit Organizations-2 CFR Part 230.

16. AVAILABLE FUNDING

The total not-to-exceed amount of Federal funding that may be provided under this grant agreement is \$2,000,000 for the entire period of performance, subject to the limitations shown below:

- (1) Currently, Federal funds in the amount of \$_____ (to be filled in at award), are obligated to this agreement.
- (2) Subject to availability of funds, and an executed document by the Agreement Officer, \$_____ (to be filled in at award) may be obligated to this agreement.

The Government's liability to make payments to the Recipient is limited to those funds obligated under this agreement as indicated above and any subsequent amendments.

17. CENTRAL CONTRACTOR REGISTRY (CCR)

The Recipient must be registered in the CCR in order to receive payments under this agreement. Use of the CCR is to provide one location for applicants and Recipients to change information about their organization and enter information on where Government payments should be made. The registry will enable Recipients to make a change in one place and one time for all Federal agencies to use. Information for registering in the CCR and online documents can be found at www.ccr.gov.

18. KEY PERSONNEL

The Recipient shall request prior written approval from the AO for any change in key personnel specified in the award. Key personnel under this agreement include:

(To be filled in at award)

19. PROGRAM INCOME

Program Income earned during the project period shall be retained by the Recipient and added to funds committed to the project by the Federal awarding agency and the Recipient and used to further eligible project or program objectives.

20. SUBAWARDS

Unless described in the application and funded in the approved award, the Recipient shall obtain prior written approval from the AO for the subaward, transfer, or contracting out of any work under this award. This provision does not apply to the purchase of supplies, material, equipment, or general support services.

21. **DEBARMENT AND SUSPENSION REQUIREMENTS**

The Recipient shall comply with Subpart C of 49 CFR Part 29, Government Debarment and Suspension (Non-procurement). Further, the Recipient shall flow down this requirement to applicable subawards by including a similar term or condition in lower-tier covered transactions. See 49 CFR Part 29 for details of the requirement. (Note: 49 CFR Part 29 is available online at <http://www.dot.gov/ost/m60/grant/regs.htm>).

22. **DRUG FREE WORKPLACE**

The Recipient shall comply with Subpart B of 49 CFR Part 32, Government-wide Requirements for Drug-Free Workplace (Financial Assistance). See 49 CFR Part 32 for details of the requirement. (Note: 49 CFR Part 32 is available online at <http://www.dot.gov/ost/m60/grant/regs.htm>).

23. **DISPUTES**

The parties to this agreement shall communicate with one another in good faith and in a timely and cooperative manner when raising issues under this Disputes provision. Any dispute, which for the purposes of this provision includes any disagreement or claim, between the FHWA and the recipient concerning questions of fact or law arising from or in connection with this Agreement and whether or not involving alleged breach of this Agreement, may be raised only under this Disputes provision.

Whenever a dispute arises, the parties shall attempt to resolve the issues involved by discussion and mutual agreement as soon as practical. In no event shall a dispute which arose more than three months prior to the notification made under the following paragraph of this provision constitute the basis for relief under this article unless FHWA waives this requirement.

Failing resolution by mutual agreement, the aggrieved party shall document the dispute by notifying the other party in writing of the relevant facts, identify unresolved issues and specify the clarification or remedy sought. Within five working days after providing written notice to the other part, the aggrieved party may, in writing, request a decision from the Agreement Officer. The other party shall submit a written position on the matters in dispute within thirty calendar days after being notified that a decision has been requested. The Agreement Officer shall conduct a review of the matters in dispute and render a decision in writing within thirty calendar days of receipt of such written position. Any decision of the Agreement Officer is final and binding unless a party shall, within thirty calendar days, request further review as provided below.

Upon written request to the FHWA Director, Office of Acquisition Management or designee within thirty calendar days after the Agreement Officer's written decision or upon unavailability of a decision within the stated time frame under the preceding paragraph, the dispute shall be further reviewed. This review shall be conducted by the Director, Office of Acquisition Management. Following the review, the Director, Office of Acquisition Management will resolve the issues and notify the parties in writing. Such resolution is not subject to further administrative review and to the extent permitted by

law, shall be final and binding. Nothing in this Agreement is intended to prevent the parties from pursuing disputes in a United States Federal Court of competent jurisdiction.

B. REPORTING

1. ADDRESSES FOR SUBMITTAL OF REPORTS AND DOCUMENTS

The Recipient shall submit all required reports and documents, to the Agreement Specialist and the AOTR electronically, referencing the cooperative agreement number, at the following address:

Carl.Rodriguez@dot.gov

Leslie.Wright@dot.gov

2. QUARTERLY PERFORMANCE PROGRESS REPORT (PPR)

The Recipient shall submit an electronic copy of the SF-PPR, in PDF format, to the AOTR and the Agreement Specialist, plus , and one hard copy to the Agreement Specialist, on or before the 30th of the month following the calendar quarter being reported. Final PPRs are due 90 days after the end of the agreement period of performance.

Calendar Quarters are:

- (1) January - March
- (2) April – June
- (3) July – September
- (4) October- December

The SF-PPR is available online at http://www.whitehouse.gov/omb/grants/grants_forms.html.

The quarterly submittal shall consist of the SF-PPR cover page and the following required attached information. Block 10 (Performance Narrative) and Block 11 (Other Attachments) of the SF-PPR shall include the following information as attached pages:

Each report shall contain concise statements covering the activities relevant to each Work Plan, including:

- a summary of work performed for the current quarter
- a summary of work planned for the upcoming quarter
- a description of any problem encountered or anticipated that will affect the completion of the work within the time and fiscal constraints as set forth in the grant agreement, together with recommended solutions to such problems; or, a statement that no problems were encountered
- A tabulation of the current and cumulative costs expended by cost element (labor, travel, indirect costs, subcontractors, etc.) by quarter versus budgeted costs, including cost share
- SF 425, Financial Status Report.

3. ANNUAL BUDGET REVIEW AND PROGRAM PLAN

The Recipient shall submit two copies of the Annual Budget Review and Program Plan to the AOTR and one copy to the Agreement Specialist 60 days prior to the end of each agreement year. The Annual Budget Review and Program Plan shall provide a detailed schedule of activities, estimate of specific performance objectives, include forecasted expenditures, and schedule of milestones for the upcoming agreement year. If there are no proposed deviations from the Approved Project Budget, the Annual Budget Review shall contain a statement stating such. The Recipient will meet with FHWA to discuss the Annual Budget Review and Program Plan. Work proposed under the Annual Budget Review and Program Plan shall not commence until AO written approval is received.

4. DELIVERABLES

Deliverables are anticipated to be made available to the public.

| <u>Deliverables</u> | <u>To be Completed on or Before</u> |
|---|-------------------------------------|
| (to be inserted at time of Work Plan award) | |

5. ENCOURAGING RECIPIENT POLICIES TO BAN TEXT MESSAGING WHILE DRIVING

(a) Definitions. As used in this clause—

“Driving”—

(1) Means operating a motor vehicle on an active roadway with the motor running, including while temporarily stationary because of traffic, a traffic light, stop sign, or otherwise.

(2) Does not include operating a motor vehicle with or without the motor running when one has pulled over to the side of, or off, an active roadway and has halted in a location where one can safely remain stationary.

“Text messaging” means reading from or entering data into any handheld or other electronic device, including for the purpose of short message service texting, e-mailing, instant messaging, obtaining navigational information, or engaging in any other form of electronic data retrieval or electronic data communication. The term does not include glancing at or listening to a navigational device that is secured in a commercially designed holder affixed to the vehicle, provided that the destination and route are programmed into the device either before driving or while stopped in a location off the roadway where it is safe and legal to park.

(b) This clause implements Executive Order 13513, Federal Leadership on Reducing Text Messaging while Driving, dated October 1, 2009.

(c) The Recipient is encouraged to—

- (1) Adopt and enforce policies that ban text messaging while driving—
 - (i) Company-owned or -rented vehicles or Government-owned vehicles; or
 - (ii) Privately-owned vehicles when on official Government business or when performing any work for or on behalf of the Government.
- (2) Conduct initiatives in a manner commensurate with the size of the business, such as—
 - (i) Establishment of new rules and programs or re-evaluation of existing programs to prohibit text messaging while driving; and
 - (ii) Education, awareness, and other outreach to employees about the safety risks associated with texting while driving.

(d) *Assistance Awards.* All Recipients and subrecipients of financial assistance to include: grants, cooperative agreements, loans and other types of assistance, shall insert the substance of this clause, including this paragraph (c), in all assistance awards.

6. REPORTING EXECUTIVE COMPENSATION

Appendix A to Part 170—Award term

I. Reporting Subawards and Executive Compensation.

a. *Reporting of first-tier subawards.*

1. *Applicability.* Unless you are exempt as provided in paragraph d. of this award term, you must report each action that obligates \$25,000 or more in Federal funds that does not include Recovery funds (as defined in section 1512(a)(2) of the American Recovery and Reinvestment Act of 2009, Pub. L. 111–5) for a subaward to an entity (see definitions in paragraph e. of this award term).

2. *Where and when to report.*

i. You must report each obligating action described in paragraph a.1. of this award term to www.fsrs.gov.

ii. For subaward information, report no later than the end of the month following the month in which the obligation was made. (For example, if the obligation was made on November 7, 2010, the obligation must be reported by no later than December 31, 2010.)

3. *What to report.* You must report the information about each obligating action that the submission instructions posted at www.fsrs.gov specify.

b. *Reporting Total Compensation of Recipient Executives.*

1. *Applicability and what to report.* You must report total compensation for each of your five most highly compensated executives for the preceding completed fiscal year, if—

i. the total Federal funding authorized to date under this award is \$25,000 or more;

ii. in the preceding fiscal year, you received—

(A) 80 percent or more of your annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR 170.320 (and subawards); and

(B) \$25,000,000 or more in annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR 170.320 (and subawards); and

iii. The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at www.sec.gov/answers/execomp.htm.)

2. *Where and when to report.* You must report executive total compensation described in paragraph b.1. of this award term:

i. As part of your registration profile at www.ccr.gov.

ii. By the end of the month following the month in which this award is made, and annually thereafter.

c. *Reporting of Total Compensation of Subrecipient Executives.*

1. *Applicability and what to report.* Unless you are exempt as provided in paragraph d. of this award term, for each first-tier subrecipient under this award, you will report the names and total compensation of each of the subrecipient's five most highly compensated executives for the subrecipient's preceding completed fiscal year, if—

i. in the subrecipient's preceding fiscal year, the subrecipient received—

(A) 80 percent or more of its annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR 170.320 (and subawards); and

(B) \$25,000,000 or more in annual gross revenues from Federal procurement contracts (and subcontracts), and Federal financial assistance subject to the Transparency Act (and subawards); and

ii. The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at www.sec.gov/answers/execomp.htm.)

2. *Where and when to report.* You must report subrecipient executive total compensation described in paragraph c.1. of this award term:

i. To the recipient.

ii. By the end of the month following the month during which you make the subaward. For example, if a subaward is obligated on any date during the month of October of a given year (*i.e.*, between October 1 and 31), you must report any required compensation information of the subrecipient by November 30 of that year.

d. *Exemptions*

If, in the previous tax year, you had gross income, from all sources, under \$300,000, you are exempt from the requirements to report:

i. Subawards, and

ii. The total compensation of the five most highly compensated executives of any subrecipient.

e. *Definitions.* For purposes of this award term:

1. *Entity* means all of the following, as defined in 2 CFR Part 25:

i. A Governmental organization, which is a State, local government, or Indian tribe;

ii. A foreign public entity;

iii. A domestic or foreign nonprofit organization;

- iv. A domestic or foreign for-profit organization;
- v. A Federal agency, but only as a subrecipient under an award or subaward to a non-Federal entity.

2. *Executive* means officers, managing partners, or any other employees in management positions.

3. *Subaward*:

i. This term means a legal instrument to provide support for the performance of any portion of the substantive project or program for which you received this award and that you as the recipient award to an eligible subrecipient.

ii. The term does not include your procurement of property and services needed to carry out the project or program (for further explanation, see Sec. __ .210 of the attachment to OMB Circular A-133, "Audits of States, Local Governments, and Non-Profit Organizations").

iii. A subaward may be provided through any legal agreement, including an agreement that you or a subrecipient considers a contract.

4. *Subrecipient* means an entity that:

i. Receives a subaward from you (the recipient) under this award; and

ii. Is accountable to you for the use of the Federal funds provided by the subaward.

5. *Total compensation* means the cash and noncash dollar value earned by the executive during the recipient's or subrecipient's preceding fiscal year and includes the following (for more information see 17 CFR 229.402(c)(2)):

i. *Salary and bonus*.

ii. *Awards of stock, stock options, and stock appreciation rights*. Use the dollar amount recognized for financial statement reporting purposes with respect to the fiscal year in accordance with the Statement of Financial Accounting Standards No. 123 (Revised 2004) (FAS 123R), Shared Based Payments.

iii. *Earnings for services under non-equity incentive plans*. This does not include group life, health, hospitalization or medical reimbursement plans that do not discriminate in favor of executives, and are available generally to all salaried employees.

iv. *Change in pension value*. This is the change in present value of defined benefit and actuarial pension plans.

v. *Above-market earnings on deferred compensation which is not tax-qualified*.

vi. Other compensation, if the aggregate value of all such other compensation (e.g. severance, termination payments, value of life insurance paid on behalf of the employee, perquisites or property) for the executive exceeds \$10,000.

SECTION VII - AGENCY CONTACT

Address any questions to:
Carl Rodriguez, Agreement Officer
Federal Highway Administration, HAAM-20F
Office of Acquisition Management
1200 New Jersey Avenue, SE
Washington, DC 20590

Carl.Rodriguez@dot.gov; (202) 366-4240

MEMORANDUM OF COOPERATION
BETWEEN
THE FEDERAL HIGHWAY ADMINISTRATION
OF
THE DEPARTMENT OF TRANSPORTATION
OF THE UNITED STATES OF AMERICA
AND
THE FORUM OF EUROPEAN NATIONAL HIGHWAY RESEARCH LABORATORIES

The Federal Highway Administration (FHWA) of the United States Department of Transportation and the Forum of European National Highway Research Laboratories (FEHRL) (hereinafter referred to as the Participants);

In accordance with the U.S.-European Union Science and Technology Agreement, signed December 5, 1997;

Desiring to establish a business protocol to achieve collaboration on solutions to problems of mutual concern in the effort to improve transportation systems and techniques by capitalizing on points of synergy and knowledge sharing between member and associate research laboratories;

Complementing the role of the FHWA as an Associate of FEHRL, which is premised on increasing cooperation and coordination to achieve collaboration efforts related in highway research, development and deployment, taking into account the shared challenges faced by the FHWA and the members of FEHRL, and the authority provided to the FHWA under 23 U.S.C. § 506 to undertake international outreach activities;

Intend to promote cooperation as follows:

Section 1
Purpose

The purpose of this Memorandum is to establish a common transparent coordination and communication platform that enables continual collaboration of Participants to leverage experience and expertise to identify and address current and future highway transport needs as part of a transportation system to meet societal goals.

Section 2 Areas of Cooperation

The Participants under this Memorandum intend to engage in strategic management and measurement of the international partnership in the following areas: research agenda setting, conduct of research, development and deployment of innovation strategies in the effort to do the right research, do it well and enable the delivery of value added results.

The Participants intend that their cooperation under this Memorandum may include research, development or deployment of technology and innovation activities in the following highway transport areas: planning, environment, right of way, asset management, materials, structures, hydraulics, traffic operations, traffic impacts, road user behavior, economics, safety, and policy.

The Participants intend for the strategic management and topics to be reviewed periodically, with amendment or adjustment based on mutual agreement. This may include expansion to other areas of cooperation.

Section 3 Forms of Cooperation

The Participants intend to strengthen cooperation in mutually understood areas in the following manner:

- a. Reference the FHWA Research and Technology Program Plans and Roadmaps and the Strategic European Road Research Programme (SERRP) to identify research, development or delivery projects that would benefit from shared FHWA and FEHRL participation through regular consultative processes and/or pooled funding;
- b. Share national and international research infrastructure (e.g., laboratory, databases, etc.) capabilities to leverage technical infrastructure and expertise to realize points of synergy;
- c. Facilitate the temporary transfer of FHWA researchers to FEHRL member laboratories and temporary transfers of FEHRL member researchers to the FHWA Turner-Fairbank Highway Research Center to provide needed expertise in the conduct of research, development or deployment activity of shared interest; and
- d. Facilitate strategic management of international research, development and deployment activities between the FHWA Associate Administrator of Research, Development and Technology, and the Director of Corporate Research, Technology and Innovation Management with the FEHRL President and Secretary General through the semi-annual meetings of the FEHRL General Assembly and of the Research Coordinators respectively and the working groups thereof.

Section 4 Intellectual Property

Each Participant expects that intellectual property which is created or furnished by it or by participating individuals or entities as described in Section 3 in the course of cooperative activities under this Memorandum, including the protection and distribution of intellectual property and information or equipment identified as requiring protection for national security reasons by either Participant, should be subject to the provisions of Annex 1 of the US-European Union Science and Technology Agreement, signed December 5, 1997.

Section 5 Funding

The pursuit of cooperative activities under this Memorandum is subject to the availability of funds. Each organization plans to bear its own labor, travel, and other costs in support of information sharing. Funding for future projects that may arise out of this Memorandum may be accomplished by reaching separate cooperative arrangements to facilitate the application of appropriate funding for agreed upon activities.

Section 6 Limitations

Cooperative activities undertaken under this Memorandum, including exchange of information, are subject to the applicable laws, regulations, policies, and procedures of each of the Participants.

Personnel performing services under this Memorandum are intended to retain their status as employees of their respective organizations. The supervision and administration of the personnel are intended to be in accordance with the policies and procedures of the agencies through which they are employed.

It is intended that all shared information should be considered public information. To the extent permitted by law, each of the Participants intends to honor disclosure restrictions as requested by the other.

Section 7 Settlement of Disputes

The Participants to this Memorandum intend to endeavor to resolve any disputes arising under this Memorandum through mutual consensus. If unsuccessful, controversies will be resolved using dispute settlement processes established for use in the US-European Union Science and Technology Agreement, signed December 5, 1997.

Section 8 Points of Contact

The points of contact are the coordinators of the activities undertaken pursuant to this Memorandum:

For FHWA: Director, Office of International Programs
Director, Office of Corporate Research, Technology, and Innovation Management

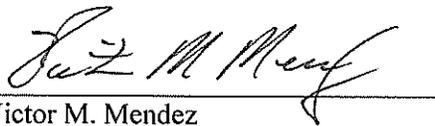
For FEHRL: Secretary General

Section 9
Duration

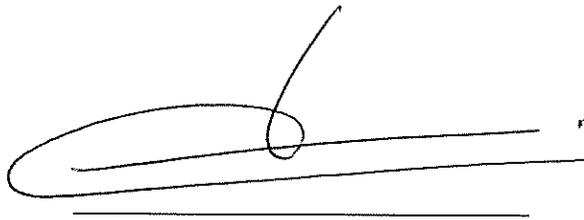
This Memorandum is intended to commence upon the date of signature below of both Participants. The Memorandum continues for a period of 6 years, and may be revised at any time by mutual consent of the Participants in writing. Each Participant may discontinue its cooperation upon ninety (90) days written notice by either Participant. The Memorandum is expected to be evaluated every two years. The Participants intend to decide whether to extend the work in the identified areas of cooperation or modify the areas to include new topics of interest.

Representatives of each Participant may select the best course of action following the biennial progress review.

Signed in, Washington this 13 day of July, 2011.



Victor M. Mendez
Administrator
Federal Highway Administration



Joris Al
President
Forum of European National Highway Research
Laboratories

Project plan

MIRIAM

Models for rolling resistance In Road
Infrastructure Asset Management
Systems



TABLE OF CONTENTS

| | | |
|-----|---|----|
| 1 | BACKGROUND AND AIM..... | 3 |
| 2 | PROJECT DESCRIPTION | 5 |
| 3 | MIRIAM 2010 – 2011 FIRST PHASE | 8 |
| 4 | PROJECT INCENTIVE..... | 9 |
| 5 | SUB-PROJECTS..... | 10 |
| 5.1 | Measurement methods and surface properties model | 10 |
| 5.2 | Investigate influence of pavement characteristics on energy efficiency | 15 |
| 5.3 | Investigate importance of Rolling Resistance on efficiency within LCA framework. 18 | |
| 5.4 | Constraints/ Requirements to implementation | 20 |
| 5.5 | External funding and raising awareness | 22 |
| 6 | PROJECT MILESTONES AND DELIVERABLES | 25 |
| 7 | PROJECT ORGANISATION – PROJECT AND SUBPROJECT LEADERS | 30 |
| 7.1 | Project steering group (PSG) | 30 |
| 7.2 | Project Manager (PM) | 30 |
| 7.3 | Project group (PG) | 30 |
| 8 | PROJECT ECONOMI – FINANSING | 31 |
| 9 | REFERENCE LIST..... | 32 |



1 BACKGROUND AND AIM

The objective of the project is to provide a sustainable and more environmentally friendly road infrastructure by developing an integrated methodology for improved control of road transport CO₂-emissions. The methodology will be implemented in road asset management systems to optimize the reduction of the part of vehicle CO₂-emission related to road pavement conditions.

The optimization of pavement quality and condition in relation to CO₂-emission and energy consumption supports the sustainable road transport issues in relation to environmental impact and will result in better quality of life for society in general.

The aim for MIRIAM (Models for rolling resistance In Road Infrastructure Asset Management systems) will be to develop models for the sources and the effects, as well as for integration and implementation, as follows:

- *The sources:* Model for rolling resistance, as related to pavement properties, with consideration also of tyres and vehicles
- *The effects:* Model for energy consumption and CO₂ emissions due to rolling resistance
- *Integration and implementation:* Model for transport infrastructure operation and management as related to rolling resistance

For passenger cars driving at a constant speed of 100 km/h, the rolling resistance accounts for 25 % of the available mechanical power output. As a percentage of the fossil fuel input it is estimated that rolling resistance losses account for 15 to 20 % for such vehicles (1).

Although there are several initiatives to reduce CO₂ emission from transport by putting demands on the vehicle emissions, the EU Commission has realised that it is not sufficient to look at the absolute emissions in the different sectors. The need for rebalancing the effort taken by the sectors and their ability to reduce CO₂ emission must therefore be assessed. A wide range of factors are influencing the CO₂ emission from the road transport sector, ranging from the demand for cars, individual mobility needs, vehicle and tyre technology, to the quality of the infrastructure.

Looking at European vehicle regulations, the Commission has adopted the **Euro 5 and 6** emission limits to reduce pollutant emissions from passenger cars and light-duty vehicles. At the Euro 5 stage, the proposal will lead to a further 80 % reduction in particulate emissions from diesel vehicles and a 20 % and 25 % reduction of NO_x emissions from diesel and petrol vehicles respectively. Euro 6 will set significantly lower emission limits for NO_x emissions from diesel cars (68 % lower than today's emission limit) (2).



Regarding tyre contribution to CO₂, a rule of thumb says that rolling resistance causes about 20 % of the CO₂ emitted by a car, and 30 % of the CO₂ emitted by a heavy truck. Tyre design, including its size, structure and materials can be optimised to obtain lower rolling resistance. The European Tyre and Rim Technical Organisation (ETRTO) specifies that low rolling resistance tyres may induce a 3 to 4 % reduction of fuel consumption and CO₂ emission, and that an ideal maintenance of the tyre, including the tyre pressure would lead to a reduction of fuel consumption and CO₂ emission in Europe of 1 to 2.5 %

Road surface characteristics influence rolling resistance and hence fuel consumption and CO₂-emission. Results from the ongoing European project: "Energy Conservation in Road Pavement Design, Maintenance and Utilisation, January 2007 - January 2010" have shown that when road surface evenness expressed by IRI [m/km] (International Roughness Index) increases one unit, then rolling resistance increases by approximate 2 % at 54 km/h and 6 % at 90 km/h. Further, this project has shown that when pavement surface texture, expressed as MPD [mm] (Mean Profile Depth), increases one unit, then rolling resistance increases by 5 - 6 % at 54 km/h and by approximately 9 % at 90 km/h (4).

Although such information on CO₂ emission variation due to vehicle, tyre and pavement influence has been published, their impacts on climate still need investigation. In order to make effective long term investment in reducing CO₂ emission due to rolling resistance, this parameter must be taken into account in road infrastructure planning and maintenance. Vehicle, tyres and pavement type, pavement use, quality and conditions need be taken into account as when quantifying CO₂-emission as a part of a system for optimum pavement maintenance and rehabilitation in Europe. A CO₂-optimized strategy for pavement renewal could be to select low rolling resistance pavements as technically, economically and environmentally friendly as possible for a given road. Pavement wear and tear should also be included as a parameter in the CO₂-part of such a system.



2 PROJECT DESCRIPTION

The content of the MIRIAM consists of four themes with a strong interaction in order to achieve the goals of the project.

Rolling Resistance data compilation and modelling

There is a basic need for reviewing existing data on tyre and pavement influence on rolling resistance. The compilation of this data is fundamental for pointing out possible gaps and the need for additional data and knowledge. Furthermore existing methods for measuring rolling resistance in the tyre/pavement interaction zone is far from fully developed. Data compilation should therefore include review of existing models and exploit new methods to determine and predict relations between rolling resistance and pavement characteristics.

Proposed outcome:

- State of the art report on existing measurement methods
- Review of existing data
- Further development of measurement methods to determine the relation between RR and pavement characteristics
- Specify a state of the art model that describes this relation

Impacts of lower Rolling Resistance

The first objective must be to assess the impact of using new pavements and tyres with lower RR on energy consumption and CO₂ emission. It is however also important to develop a model that predicts and describes the development of CO₂ emissions and energy consumption during a life cycle of in-service pavements and tyres by looking at a number of common scenarios.

In order to perform strategic optimization and determine the effective level of RR investigations, economical implications of using RR parameter in road asset management systems are needed. Introducing new performance related parameters often have an effect on others. Therefore, when introducing pavements or maintenance solutions providing lower RR, the effect on parameters such as skid resistance, noise, comfort, wear and tear as well as global society impacts needs also to be investigated. In addition, the “up-stream” environmental effects of material production and construction, and the “down-stream” effects of ongoing maintenance and rehabilitation must be assessed in conjunction with the vehicle use phase of the life cycle. Performing Cost/Benefit analysis does necessitate a value setting of CO₂ emissions, which will be done in co-operation with the political level.



Proposed outcome:

- A model that describes the effects of using different pavements with RR on energy consumption and CO₂ emission during its lifecycle.
- A model that describes the effects of using tyres with lower RR on energy consumption and CO₂ emission.
- A model that predicts the changes of CO₂ emitted by vehicle rolling resistance in relation to pavement type and condition for a complete road network.
- A model that integrates the three above models
- A model that predicts CO₂ emissions caused by tyres during their lifecycle
- Inventory of consequences of lower RR on other performance indicators
- Inventory of economic implications of deployment of lower RR (tyre and pavement)

Implementation

There is a fundamental need for assessing the effects of rolling resistance on energy consumption and CO₂ reduction within various scenarios of implementation of the project results. This should include a description of possibilities for further improvement of pavements using more advanced materials and technologies.

Furthermore there is a need to study how various scenarios of MIRIAM implementation can effect climate changes. This will be an important tool for decision makers, when making climate policies.

A significant part of implementation is securing support at decision maker level. A plan for creating awareness at decision maker level in order to propose policy changes are therefore a must to be completed within the project scope

Implementing RR models in pavement management systems can cause potential conflicts with other performance indicators. The preparation should hence include suggestion to overcome potential barriers by performing risk analysis.

Finally general guidelines for implementation of RR models in pavement performance systems must be prepared.

Proposed outcome:

- Action plan describing various scenarios for RR impact on CO₂ after implementation of MIRIAM
- Recommendation for decision makers based on these scenarios
- Guidelines for selecting appropriate projects for use of lower RR pavements, and design, construction and maintenance to achieve low RR pavements
- Guidebook for implementation of MIRIAM
- Analysis of economic effects of various RR strategies by means of multi-criteria cost/benefit analysis



Training and Dissemination

Whereas the implementation theme deals with preparatory issues, the training and dissemination theme handles the actual use of MIRIAM.

Two objectives must be addressed in this theme;

1) Secure a correct and easy implementation of MIRIAM in the Road Asset Management Systems

- In order to do this, a task force will conduct training sessions, which will enable road administrators to implement MIRIAM correctly and easily.

2) Ensure that the project results are anchored widely among the road administrations

- It is of utmost importance for the fostering and implementation of MIRIAM, that it is well supported at decision maker level. Therefore a road show aiming at politicians, road administrations and contractors will be conducted. The road show will explain how MIRIAM is an effective tool with regard to setting up and achieving energy-saving and CO₂-reducing goals.

Proposed outcome:

- Dissemination and deployment plan for MIRIAM
- A European seminar/road show aiming at policy makers, describing the MIRIAM tools
- Fostering of the use of low RR surfaces and tyres
- Training sessions



3 MIRIAM 2010 – 2011 FIRST PHASE

The first phase of the MIRIAM project will cover the following five sub-projects

- Measurement methods and surface properties model
- Investigation of the influence of pavement characteristics on energy efficiency
- Investigation of the importance of Rolling Resistance on efficiency within LCA framework
- External funding and raising awareness
- Constraints/ Requirements to implementation



4 PROJECT INCENTIVE

Globally, road transport is a major contributor to greenhouse gas emission and is one of the few energy consuming sectors where the emissions are increasing. Fuel consuming passenger cars have a significant impact on climate change, and in Europe they account for app. 12 % of the total CO₂ emission. It is noticeable that even though the EU as a whole has reduced greenhouse gas emission by just below 5 % from 1990 to 2004, the CO₂ emission from road transport has increased by 26 %.

In California, USA, fuel-consuming passenger cars and trucks account for 36% and passenger cars contribute 29% of all equivalent CO₂ emissions.

Measuring rolling resistance, the energy consumed hereby and the amount of CO₂ emitted is a first step towards incorporating CO₂ values in road asset management systems.

Developing models for rolling resistance in road infrastructure asset management systems allows the road administrations to forecast the amount of CO₂ emitted by vehicle rolling resistance in relation to pavement type and condition for a complete road network. Hereby it becomes possible to optimize pavement rehabilitation strategies and specify pavement types with low rolling resistance.

MIRIAM will provide a strategic tool for decision makers for setting up and achieving energy-saving and CO₂-reducing goals



5 SUB-PROJECTS

The first phase of the MIRIAM project covering 2010 to 2011 has been divided into 5 sub-projects each with its own sub-project leader and project team. For each of these sub-projects specific resources are allocated in terms of person-months and budget. Each sub-project has its own goals to be achieved; expressed in work items, milestones and deliverables

Participants in the sub-projects are:

- Austrian Institute of Technology (AIT), Austria
- Belgian Road Research Centre (BRRC), Belgium
- Danish Road Institute (DRI), Denmark
- Norwegian Public Roads Administration (NPRA), Norway
- Swedish National Road and Transport Research Institute (VTI), Sweden
- Swedish Road Administration (SRA), Sweden
- Technical University of Gdansk (TUG), Poland
- Slovenian National Building and Civil Engineering Institute (ZAG), Slovenia
- University of California, Pavement Research Center (UC Davis and Berkeley, (UCPRC) USA
- California Department of Transportation (CT), USA

5.1 MEASUREMENT METHODS AND SURFACE PROPERTIES MODEL

5.1.1 Sub-project leader

The Sub-project will be led by Ulf Sandberg of the Swedish National Road and Transport Research Institute (VTI), Sweden.

5.1.2 Participants

- Austrian Institute of Technology (AIT), Austria
- Belgian Road Research Centre (BRRC), Belgium
- Danish Road Institute (DRI), Denmark
- Swedish National Road and Transport Research Institute (VTI), Sweden
- Technical University of Gdansk (TUG), Poland
- University of California, Pavement Research Center (UC Davis and Berkeley, (UCPRC), USA

5.1.3 Duration

2010-01-01 to 2011-12-31



5.1.4 Person-months per participant

| Participant | AIT | BRRC | DRI | VTI | TUG | UCPRC | Total |
|-------------|-----|------|-----|-----|-----|-------|-------|
| PM | 1,2 | 2,5 | 1 | 9 | 7,1 | 2 | 22,8 |

5.1.5 Objectives

The objectives of Phase 1 of this sub-project are as follows:

- To develop a robust terminology related to rolling resistance; including definition of the term itself.
- To collect information about the State-of-the-Art of measurement of rolling resistance and report this.
- To develop and test laboratory as well as on-the-road measurement methods for rolling resistance.
- To validate the performance of available equipment needed to perform measurements with the measurement methods.
- To develop a test programme for the survey of rolling resistance of the most important tyres and road surface types.
- To collect data with regard to rolling resistance of the most important tyres and road surface types.
- To collect information about source models for rolling resistance and report this in a State-of-the-Art report.

5.1.6 Description of work

WI 5.1.1 Terminology

There is confusion with regard to what kind of energy losses that should be considered as part of the rolling resistance. This Work Item (WI) will identify significant sources of energy losses in propulsion of road vehicles, look at the various definitions found in standards and literature, as well as discuss the limitations as to what can/should be regarded as rolling resistance. Some other major parameters related to the subject will also be defined. All the sources will be discussed in relation to major measurement methods. The ECRPD project will be a major source for this WI. A definition of RR for use in MIRIAM will be suggested.

WI 5.1.2 State-of-the-Art report about measurement of rolling resistance

A State-of-the-art paper with the tentative title "Measurement methods and equipment for rolling resistance of tyres and road surfaces -- a critical review" will be produced. The report should among others contain the following items:

- A historical review
- Various methods used (drums, trailer, coast-down, fuel consumption)
- Formal measurement standards (ISO, SAE)
- Methods not yet implemented but potentially useful in the future (if any)



- Correlations between the methods
- Reference tyres
- Reference surfaces
- Environmental influence (temperature, wind, humidity, etc)
- Wet versus dry surfaces, winter versus summer conditions
- In what way will the result be applied in the implementation phases of MIRIAM
- Recommendations

The report shall consider methods and equipment suitable for testing of both tyres and road surfaces, with regard to both cars and trucks, worn versus new tyres, as well as laboratory and field methods. Methods that measure rolling resistance indirectly shall also be reviewed; for example the coast-down technique and the fuel consumption method, which both utilize instrumented full vehicles as measurement objects.

There are some standards in ISO and SAE for measurement of rolling resistance of tyres. However, these have serious drawbacks; for example, regarding how representative they are. The probably largest problem is that measurements are made with the reference surface being a smooth steel surface. Tyres on roads do not run on smooth steel surfaces, which mean that tyres optimized for rolling resistance will be inappropriately constructed. The report shall look especially at the selection of reference tyre(s) for measurement of rolling resistance of road surfaces. It shall also identify suitable methods for measuring rolling resistance of road surfaces and recommend one or more that are suitable for the purpose.

WI 5.1.3 Development of measurement methods for rolling resistance

This Work Item shall seek to improve existing standards for measurements of tyre rolling resistance and develop new ones where methods are non-existing. The latter applies to measurements of the rolling resistance of road surfaces. Methods that should be considered as potential for standardization might include the trailer method, the coast-down method and the fuel consumption method. Reference tyre(s) for measurement of rolling resistance of road surfaces shall be selected, including justifications. Properties of tyre/vehicle suspension systems shall be considered.

Parameters such as tyre inflation pressure, inflation gas, tyre load, measurement speeds, minimum measured length, etc, shall be specified in the draft procedures. It shall also be considered whether tyre inflation pressure shall be held constant as the test tyre warms up or whether only cold inflation pressure shall be kept constant.

It may be necessary to do some pre-normative experiments in this WI. In any case, when they are ready to use, it shall be verified by tests if the method(s) meet the intended purpose or not when they are ready to be used.



It shall be the ambition that the work in this WI will become a basis for a European or an International standard.

WI 5.1.4 Testing of equipment for measurement of rolling resistance (RRT)

Once the method(s) are developed, it is time to look at what instrumentation and equipment are needed to perform the tasks of the method(s). Useful equipment shall be described, both within and outside the project consortium.

The sensitivity to ambient parameters, such as air, tyre and road surface temperature shall be established.

Then an international round robin test (RRT) shall be planned and performed. All equipment intended for use in this project, and others that may be interesting for future use shall gather at some place having a suitable test track, and a measurement program shall be carried out with the aim to compare the equipment to each other and to see how well they meet the objectives. Possible places for such a common experiment may be the LCPC test track in Nantes, France, and the Sperenberg test track south of Berlin, Germany. The tracks to be included in the RRT should include a few with real high levels of macrotexture and megatexture and a few with low levels of the same. The test tracks selected for testing shall also display very different characteristics in the macro- and megatexture ranges, in order that there is poor correlation between megatexture and macrotexture of the selected test tracks. If such properties are not found on the test track, it may be sought among road surfaces subject to traffic and such surfaces be added as appropriate into the test program.

The RRT shall have as one of its aims to compare the results of the measurement methods, and the correlation between them, in case more than one method has been developed. After completion of the RRT and its analyses it is likely that the draft measurement methods must be revised. The Deliverable D 4.1.2 shall then be updated (if necessary).

WI 5.1.5 Production of a testing programme

The WI shall begin by identifying the needs for experimental work, such as surveys of RR of tyres and road surfaces. A test programme shall then be worked out. This programme shall aim at measuring the rolling resistance properties of a large range of tyres and road surfaces. It shall be the aim to include the most interesting/important surface types in the participating countries. One shall keep in mind that this shall be used as basic data for inclusion in PMS systems in the participating countries and surfaces commonly used shall then not be neglected. Wherever there are existing (relevant) data for tyres and road surfaces these shall be used as a supplement to measurements.



The justification for the test programme shall be presented. Rolling resistance is the result of an interaction between tyre and road surfaces; to some extent also including the vehicle. It shall be noted that not only road surfaces but also tyres need to be tested. One reason for this is that one would like to see how the selected reference tyres compare to the whole market; i.e. how representative they are. Another reason is that the data collection and the establishment of a database will make it possible to see how authorities and individuals may select their tyres for economical and "environmentally friendly" driving. Authorities will have the possibility to include in their "green transportation" initiatives these tyre data for consideration in various forms and applications.

Experiments in both Europe and North America shall be considered. As pavement policies are quite different on the two continents it is useful to survey the pavements on both continents and to put all results together for common analysis and modelling. This test programme should include cost estimations and contain a few levels of ambition in order to match available funding and needs.

WI 5.1.6 State-of-the-art paper on "Source models for calculation of rolling resistance of tyres and road surfaces"

This report shall identify the sources of rolling resistance and look at how rolling resistance from the tyre/road interaction can be modelled based on data describing the condition of the source; for example road unevenness and texture. It shall identify what should be modelled and how accurate it should be done. The purposes and uses are other items to discuss. Existing models shall be described and classified. Model validation, problems, shortcomings, accuracy and further development needs shall be considered. Finally, it shall be discussed in what way this may be applied in the implementation phases of MIRIAM. Finally, an overall evaluation and recommendations shall be made.

5.1.7 Milestones and expected results

- MS 5.1.1 Review process of terminology related to rolling resistance completed.
Time: 31 May 2010.
- MS 5.1.2 Review process of existing measurements methods completed.
Time: 31 August 2010.
- MS 5.1.3 Measurement methods developed.
Time: 31 March 2011.
- MS 5.1.4 Measurement programme for RRT worked out and accepted.
Time: 31 May 2011.



5.1.8 Deliverables

- D 5.1.2 State-of-the-Art report: Methods and Equipment for Measurement of Rolling Resistance of Tyres and Road surfaces – A Critical Review. This should present also the terminology considerations.
Time: 30 Sep 2010.
- D 5.1.2 Report: Proposed measurement methods and available test equipment.
Time: 31 May 2011 (this report may need revision after D 4.1.3 is completed).
- D 5.1.3 Report: Results of the RRT and other measurements validating the performance of the methods and equipment.
Time: 31 Dec 2011.
- D 5.1.4 State-of-the-Art report "Source models for calculation of rolling resistance of tyres and road surfaces".
Time: 31 Dec 2011.

5.1.9 Relation to other parts of MIRIAM

This sub-project will constitute a base on which much of the following work in MIRIAM will rely. This applies especially to sub-project "Investigate influence of pavement characteristics on energy efficiency".

5.2 INVESTIGATE INFLUENCE OF PAVEMENT CHARACTERISTICS ON ENERGY EFFICIENCY

5.2.1 Sub-project leader

The Sub-project will be led by Stefan Deix of the Austrian Institute of Technology (AIT), Austria.

5.2.2 Participants

- Austrian Institute of Technology (AIT), Austria
- Belgian Road Research Centre (BRRC), Belgium
- Danish Road Institute (DRI), Denmark
- Norwegian Public Roads Administration (NPRA), Norway
- Swedish Road Administration (SRA), Sweden
- Swedish National Road and Transport Research Institute (VTI), Sweden
- University of California, Pavement Research Center (UC Davis and Berkeley, UCPRC), USA
- University of California at Davis (UCD), USA
- Slovenian National Building and Civil Engineering Institute (ZAG), Slovenia

5.2.3 Duration

2010 – 2011



5.2.4 Person month per Participants

| Participant | AIT | BRRRC | DRI | NPRA | SRA | VTI | UCPRC /CT | ZAG | Total |
|-------------|-----|-------|-----|------|-----|-----|-----------|-----|-------|
| PM | 7 | 1 | 2 | 0,5 | 0,5 | 4 | 4 | 1,4 | 20,4 |

(NPRA, SRA, ZAG, CALTRANS for WI 2.2 in this SP2)

5.2.5 Objectives

Determine the range of influencing parameters in road characteristics on energy efficiency in road transport. This comprises:

1. Identification of influencing road characteristics in literature
2. Current practice and conditions of roads with respect to energy efficiency in European and US countries (an excerpt)
3. Estimation of saving potentials of various influencing criteria on energy consumption
4. Survey on interdependency of energy consumption for different driving states (acceleration, constant speed, deceleration) road characteristics and vehicle types

5.2.6 Description of work items

WI 5.2.1 Existing knowledge and literature review

The objective of this work item will be reached by conducting literature surveys and project reviews on energy consumption and road infrastructure parameters. Specifically the definitions for rolling resistance of pavements in various countries will be reviewed and compiled. Moreover, other pavement characteristics (e.g. longitudinal evenness, texture, stiffness, ruts) with potential impact on energy consumption in road transport will be summarized. Useful sources will be European FP projects, PIARC, standardisation bodies, academics, PIARC, FEHRL Knowledge Centre, etc. The result of WI 5.2.1 is necessary for WI 5.2.3 and WI 5.2.4.

WI 5.2.2 Current practice in extracts for EU and US

The objective of this WI is to identify current practices and conditions of roads with respect to energy efficiency in European and US countries. For this purpose an adequate questionnaire needs to be prepared. As the project group may not guarantee a full large scale European (or US) survey on road conditions, the first task will be the definition and scope for this WI based on the commitment of participating countries and associated members in different countries (coordinate efforts with SP4 and SP5). This WI is mainly driven by



the road authorities within the project group and corresponding research institutes. The FEHRL Research coordinators will be questioned to contribute with specific information to this topic. The result will be used in WI 5.2.4.

WI 5.2.3 Analyse impact of road characteristics for different driving states and vehicle types on energy consumption

The aim of this WI is to collect information and to analyse the impact of pavement surface characteristics and road characteristics for various driving states and different vehicle types on energy efficiency. Due to obvious differences of vehicles, tyres and driving states (acceleration, constant speed and deceleration) the impact of road surface conditions will vary for:

- a. Cars
- b. HGVs
- c. Urban transport
- d. Interurban transport

Therefore the work (literature surveys and simulations) in WI 5.2.3 will be structured according to this categorisation. The results of this WI 5.2.3 will be used in WI 5.2.4.

WI 5.2.4 Energy saving potentials in road (characteristics)

The aim in WI 5.2.4 is to evaluate results from WI 5.2.1, WI 5.2.2 and WI 5.2.3 based on energy savings potentials in roads. The combination and synthesis of these results will be used in WI 5.2.4 to estimate the energy saving potentials in road transport due to optimised road (pavement) characteristics.

5.2.7 Milestones and expected results

- MS 5.2.1 Literature survey for WI 5.2.1 completed
Time: 31 May 2010.
- MS 5.2.2 Information collection and evaluation on in-service roads finished
Time: 31 December 2010.
- MS 5.2.3 Information about surface characteristics, driving states and vehicle types analysed
Time: 31 August 2011.
- MS 5.2.4 Report on Energy saving potentials in road (characteristics) finished
Time: 31 December 2011.



5.2.8 Deliverables

- D 5.2.1 Discussion paper – “What is Rolling Resistance and other influencing parameters on energy consumption in road transport?”
Time: 30 June 2010.
- D 5.2.2 Report: Survey of the condition of in-service roads and potentials in energy savings by reducing rolling resistance
Time: 31 January 2011.
- D 5.2.3 Report: Impact of pavement characteristics on energy efficiency for different driving states and vehicle types
Time: 30 September 2011.
- D 5.2.4 Report: Energy saving potentials in road (characteristics)
Time: 31 December 2010.

5.2.9 Relation to other parts of MIRIAM

- Reconcile and complete list of relevant literature with SP 5.1. Exchange and use of technical specification from SP 5.1 on Rolling Resistance (used in WI 5.2.1)
- Exchange and use of information on identified European and North American LCA system boundary definitions, data sets and models for road pavements with SP 5.3 (used in WI 5.2.2)
- Reconcile questionnaire in SP 5.5 with WI 5.2.2 and combine if possible
- Deliver D 5.2.4 to SP 5.4 and SP 5.5

5.3 INVESTIGATE IMPORTANCE OF ROLLING RESISTANCE ON EFFICIENCY WITHIN LCA FRAMEWORK

5.3.1 Sub project leader

The Sub-project will be lead by John Harvey, University of California, Pavement Research Center (UCPRC), USA

5.3.2 Participants

- Swedish Road Administration (SRA), Sweden
- Swedish National Road and Transport Research Institute (VTI), Sweden
- University of California Pavement Research Center (UCPRC), USA
- Slovenian National Building and Civil Engineering Institute (ZAG), Slovenia

5.3.3 Duration

2010 to 2011



5.3.4 Person month pr Participants

| Participant | SRA | VTI | UCPRC | ZAG | Total |
|-------------|-----|-----|-------|-----|-------|
| PM | 3 | 6 | 14 | 1,4 | 24,4 |

5.3.5 Objectives

To answer the following questions at the conceptual level using LCA modelling and sensitivity analysis

- A: What is the importance of pavement surface characteristics on energy use relative to other contributors to energy use in the road transport sector?
- B: Using sensitivity analysis within an ISO compliant LCA model, what is the magnitude of change in energy use that might occur from changes in pavement surface characteristics?
- C: Approximately what is the potential direct cost of such changes?
- D: How does that cost compare with a reasonable estimate of the potential vehicle fuel use savings?
- E: What are the potential ranges of indirect benefits and costs, such as reduction in waste tires, increased accidents, reduction in storm water pollution from tire particles, noise reduction, reduce vehicle wear, etc, that might reasonably occur from changes in pavement surface characteristics and/or use of more fuel efficient tires?

5.3.6 Description of work items

WI 5.3.1 Identify European and North American LCA system boundary definitions, data sets and models for road pavement.

WI 5.3.2 Review critical model assumption and data set

Review critical model assumptions and data sets for applicability to industrial practice in Europe and North America and make decisions for use in modelling. Develop documentation requirements for LCA analysis of pavements to permit comparison of other LCA studies. Identify gaps, and uncertainties in knowledge and data (data reflecting out of date technology, inapplicability to certain regions, etc), and highlight differences in appropriate modelling assumptions and data sets for Europe and North America.

WI 5.3.3 Final decisions about models

Make final decisions about models, assumptions and data sets, develop an experimental plan for sensitivity analysis

WI 5.3.4 Perform sensitivity analyses using models



WI 5.3.5 Write report

5.3.7 Milestones

- MS 5.3.1 Workshop to review LCA model framework, initial review of data sets, preliminary documentation requirements, identification of critical assumptions
Time: 1 June 2010
- MS 5.3.2 Decision on models, data sets, assumptions, documentation
Time: 15 August 2010
- MS 5.3.3 Sensitivity analysis using models performed
Time: 15 October 2010
- MS 5.3.4 First draft report completed
Time: 1 February 2011

5.3.8 Deliverables

- D 5.3.1 Technical memorandum: Summary of LCA workshop
Time: 15 July 2010
- D 5.3.2 Report: Importance of Rolling Resistance on efficiency within LCA framework
Time: 1 April 2011

5.3.9 Relation to other parts of MIRIAM

- Provide information for WI 5.2.1 regarding temporal and regional validity of models and data sets for rolling resistance influence on various LCA output parameters (fuel use, emissions etc.)
- Model impacts of current practice on LCA output parameters providing information to 5.2.3

5.4 CONSTRAINTS/ REQUIREMENTS TO IMPLEMENTATION

5.4.1 Sub project leader

The Sub-project will be lead by Armand Der-Stepanian, Danish Road Institute, Denmark

5.4.2 Participants

- Danish Road Institute (DRI), Denmark
- Norwegian Public Roads Administration, NPRA, Norway
- Swedish Road Administration (SRA), Sweden
- Swedish National Road and Transport Research Institute (VTI), Sweden
- University of California Pavement Research Center (UCPRC), USA
- California Department of Transportation (CT), USA



5.4.3 Duration

2010 to 2011

5.4.4 Person month pr Participants

| Participant | DRI | NPRA | SRA | UCPRC | CT | Total |
|-------------|-----|------|-----|-------|----|-------|
| PM | 2 | 2 | 2 | 2 | 1 | 9 |

5.4.5 Objectives

Determine the constraints and requirements in existing pavement management systems or asset management systems for implementing processes for handling rolling resistance as part of the optimization and strategic maintenance and rehabilitation.

5.4.6 Description of work items

WI 5.4.1 Questionnaire concerning implementation

Draft a questionnaire to be sent to road administrations regarding implementing new parameters.

In order to map the use of pavement and asset management systems in Europe and North America and to investigate the use of optimization models and respective condition parameters a questionnaire will be drafted and sent to relevant organisations and road authorities.

The questionnaire shall cover in what aspects road authorities are using climate related parameters such as CO₂ emissions in pavement maintenance and rehabilitation strategies. The questionnaire shall also seek answers concerning possibilities for implementing new parameters such as rolling resistance and how this could be tackled.

The questionnaire shall be ready October 1. 2010

WI 5.4.2 Evaluate incoming answers

An expected reply date for the questionnaire is January 1 2011. Then the evaluation and review of the questionnaire shall take place from January 1 to May 1 2011 including a report describing the answers and feedback from the questionnaire.

WI 5.4.3 Prepare a guideline for implementation of new parameters

From May 1 to November 1 a guideline shall be written based on the evaluation of the questionnaires and expertise within the MIRAM partners. The guideline shall recommend procedures and implementation plans for including pa-



rameters, deterioration and optimization models describing rolling resistance and CO₂ emissions in asset management systems.

5.4.7 Milestones

MS 5.4.1 Send out questionnaire

Time: 30. September 2010.

MS 5.4.2 Report based on questionnaires

Time: 30. April 2011.

MS 5.4.3 Guidelines

Time: 31. October 2011

5.4.8 Deliverables

D 5.4.1 Report on implementation constraints based on results from questionnaire

Time: 30. April 2011.

D 5.4.2 Report: Guidelines for implementation of Rolling resistance in Asset Management systems

Time: 31 October 2011.

5.4.9 Relation to other parts of MIRIAM

The subproject will relate and consult sub-project 5.2 and 5.3

5.5 EXTERNAL FUNDING AND RAISING AWARENESS

5.5.1 Sub project leader

The Sub-project will be lead by Brian G. Larsen, Danish Road Institute, Denmark

5.5.2 Participants

- Austrian Institute of Technology (AIT), Austria
- Belgian Road Research Centre (BRRC), Belgium
- Danish Road Institute (DRI), Denmark
- Norwegian Public Roads Administration, NPRA, Norway
- Swedish National Road and Transport Research Institute (VTI), Sweden
- Swedish Road Administration, SRA, Sweden
- Technical University of Gdansk (TUG), Poland
- University of California Pavement Research Center (UCPRC), USA
- Slovenian National Building and Civil Engineering Institute, ZAG, Slovenia



5.5.3 Duration

2010 – 2011 (there will be a significant involvement of resources in the period late from mid 2010 to late 2010 due to a possible EU RTD application)

5.5.4 Person month pr Participants

| Participant | AIT | BRRC | DRI | NPRA | SRA | VTI | TUG | UCPRC | ZAG | Total |
|-------------|-----|------|-----|------|-----|-----|-----|-------|-----|-------|
| PM | 1 | 0,5 | 3 | 1 | 1 | 2 | 1 | 1 | 0,5 | 11 |

5.5.5 Objectives

The overall objective of this sub-project is to secure sufficient financial resources for the second Phase of MIRIAM. Potential funds for this phase can be divided into two groups; 1) Resource contribution from NRA's and the private industry will at one hand be a target group for the funding work. 2) The primary target is, however, to get funding from the FP7 programmes 2011 call which will be opened in August? 2010. The main output from this sub-project is hence an application for this FP7 call - Other funding pools or programmes such as ERANET ROAD joint calls will also be considered.

5.5.6 Description of work items

WI 5.5.1 Raise awareness of the MIRIAM Project

This work item aims at raising awareness of the MIRIAM project. The target groups are all potential funding bodies, as listed above. The work will include presentation of the MIRIAM Project at relevant conferences such as TRB, TRA etc. Furthermore contact with the commission will be upheld prior to the launch of the FP7 call in order to influence the decision makers.

WI 5.5.2 Seeking funds from NRA's and other organizations

Even though the main target for the funding work is the FP7 programme, other potential partners must also be taken into account. This applies for funding of both the first and the second phase of MIRIAM.

WI 5.5.3 Application for FP7 2011 call

The work required on this application will be significant and will be the largest task in this sub-project. An external consultant will be hired in order to check the quality of the content of the application



WI 5.5.4 Application for other calls

The sub-project group will identify other potential calls –especially the two calls made in ERANET ROAD (ENR) must be considered.

5.5.7 Milestones and expected results

- MS 5.5.1 February 2010 - Launch of ENRII's first joint call
- MS 5.5.2 March 2010 – Deadline for applications for first ENR joint call
- MS 5.5.3 May 2010 - Winners of ENR joint call appointed and contracts signed
- MS 5.5.4 July 2010 - Launch of call for FP7 transport programme opens?
- MS 5.5.5 January 2011 – Deadline for applications for FP7 transport programme applications
- MS 5.5.6 February 2011 – Launch of ENRII's second joint call – application if relevant
- MS 5.5.7 April 2011 - Deadline for applications for second ENR joint call
- MS 5.5.8 May 2011 – Winners of ENR second joint call appointed and contracts signed
- MS 5.5.9 December 2011 Winners of FP7 research programme appointed

5.5.8 Deliverables

- D 5.5.1 Application for ENRII joint calls (potential deliverable)
- D 5.5.2 Application for FP/ programme

5.5.9 Relation to other parts of MIRIAM

The sub-project has relations to all MIRIAM sub-project as it obligation is to seek additional funding.



6 PROJECT MILESTONES AND DELIVERABLES

| Sub-project | Milestones | | Deliverables | |
|---|--|----------------|---|--------------------|
| | Description | Deadline | Description | Deadline |
| 5.1 Measurement methods and surface properties model | MS 5.1.1 Review process of terminology related to rolling resistance completed. | May 31. 2010 | D 5.1.2 State-of-the-Art report: Methods and Equipment for Measurement of Rolling Resistance of Tyres and Road surfaces – A Critical Review. This should present also the terminology considerations. | September 30. 2010 |
| | MS 5.1.2 Review process of existing measurements methods completed. | August 31 2010 | D 5.1.2 Report: Proposed measurement methods and available test equipment. (<i>this report may need revision after D 4.1.3 is completed</i>). | May 31. 2011 |
| | MS 5.1.3 Measurement methods developed. | March 31 2011 | D 5.1.3 Report: Results of the RRT and other measurements validating the performance of the methods and equipment. | December 31. 2011 |
| | MS 5.1.4 Measurement programme for RRT worked out and accepted. | May 31 2011 | D 5.1.4 State-of-the-Art report "Source models for calculation of rolling resistance of tyres and road surfaces". | December 31. 2011 |



| Sub-project | Milestones | | Deliverables | |
|--|--|-------------------|---|--------------------|
| | Description | Deadline | Description | Deadline |
| 5.2 Investigate influence of pavements characteristics on energy efficiency | MS 5.2.1 Literature survey for WI 5.2.1 completed | 31. May 2010 | D 5.2.1 Discussion paper – “What is Rolling Resistance and other influencing parameters on energy consumption in road transport” | 30. June 2010 |
| | MS 5.2.2 Information collection and evaluation on in-service roads finished | 31. December 2010 | D 5.2.2 Report: Survey of the condition of in-service roads and potentials in energy savings by reducing rolling resistance | 31. January 2011 |
| | MS 5.2.3 Information about surface characteristics, driving states and vehicle types analysed | 31. August 2011 | D 5.2.3 Report: Impact of pavement characteristics on energy efficiency for different driving states and vehicle types | 30. September 2011 |
| | MS 5.2.4 Report on Energy saving potentials in road (characteristics) finished | 31. December 2011 | D 5.2.4 Report: Energy saving potentials in road (characteristics) | 31. December 2010 |



| Sub-project | Milestones | | Deliverables | |
|--|---|------------------|--|---------------|
| | Description | Deadline | Description | Deadline |
| 5.3 Investigate importance of Rolling Resistance on efficiency within LCA framework | MS 5.3.1 Workshop to review LCA model framework, initial review of data sets, preliminary documentation requirements, identification of critical assumptions | 1. June 2010 | D 5.3.2 Technical Memorandum: Summary of LCA workshop | 15. July 2010 |
| | MS 5.3.2 Decision on models, data sets, assumptions, documentation | 15. August 2010 | D 5.3.2 Report: Importance of Rolling Resistance on efficiency within LCA framework | 1. April 2011 |
| | MS 5.3.3 Sensitivity analysis using models performed | 15. October 2010 | | |
| | MS 5.3.4 First draft report completed | 1. February 2011 | | |



| Sub-project | Milestones | | Deliverables | |
|--|--|-----------------------|--|---------------------|
| | Description | Deadline | Description | Deadline |
| 5.4 Con- straints/ Re- quirements to implementa- tion | MS 5.4.1 Send out question- naire | 30. September 2010 | D 5.4.1 Report on imple- mentation con- straints based on results from ques- tionnaire | 30. April 2011 |
| | MS 5.4.2 Report based on questionnaires. | 30. April 2011 | D 5.4.2 Report: Guidelines for implementation of Rolling resistance in Asset Manage- ment systems | 31. October 2011 |
| | MS 5.4.3 Guidelines written | 30. October 2011 | | |



| Sub-project | Milestones | | Deliverables | |
|---|--|---------------|--|----------|
| | Description | Deadline | Description | Deadline |
| 5.5 External funding and raising awareness | MS 5.5.1 Launch of ENRII's first joint call | February 2010 | D 5.5.1 Application for ENRII joint calls (potential deliverable) | |
| | MS 5.5.2 Deadline for applications for first ENR joint call | March 2010 | D 5.5.2 Application for FP/ programme | |
| | MS 5.5.3 Winners of ENR joint call appointed and contracts signed | May 2010 | | |
| | MS 5.5.4 Launch of call for FP7 transport programme opens | July 2010 | | |
| | MS 5.5.5 Deadline for applications for FP7 transport programme applications | January 2011 | | |
| | MS 5.5.6 Launch of ENRII's second joint call – application if relevant | February 2011 | | |
| | MS 5.5.7 Deadline for applications for second ENR joint call | April 2011 | | |
| | MS 5.5.8 Winners of ENR second joint call appointed and contracts signed | May 2011 | | |
| | MS 5.5.9 Winners of FP7 research programme appointed | December 2011 | | |



7 PROJECTORGANISATION – PROJECT AND SUBPROJECT LEADERS

7.1 PROJECT STEERING GROUP (PSG)

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Stefan Deix, Austrian Institute of Technology (AIT), Austria
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7.2 Project Manager (PM)

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8 PROJECT ECONOMY – FINANCING

| <i>Contribution type</i> | | |
|--------------------------|---------------------------------|----------------|
| Partner | Man Month expressed in € | € |
| DRD/DRI | | 150 000 |
| AIT | 90 000 | |
| TUG | 70 000 | |
| NPRA | | 80 000 |
| ZAG | 20 000 | |
| SRA | | 150 000 |
| VTI | | 20 000 |
| BRRC | 60 600 | |
| UCPRC | 215 250 | |
| CT | 31 000 | - |
| Sum | 486 850 | 400 000 |
| TOTAL | | 886 850 |

| Partner | sub-project | | | | | | Sum |
|----------------|------------------------------|-------------|-------------|------------|------------|--|-------------|
| | Man Month pr. partner | | | | | | |
| | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | | |
| AIT | 1,2 | 7,0 | | | 1,0 | | 9,2 |
| BRRC | 2,5 | 1,0 | | | 0,5 | | 4,0 |
| DRI | 1,0 | 2,0 | | 2,0 | 3,0 | | 8,0 |
| NPRA | | 0,5 | | 2,0 | 1,0 | | 3,5 |
| VTI | 9,0 | 4,0 | 6,0 | | 2,0 | | 21,0 |
| SRA | | | 3,0 | 2,0 | 1,0 | | 6,0 |
| TUG | 7,1 | | | | 1,0 | | 8,1 |
| ZAG | | 1,4 | 1,4 | | 0,5 | | 3,3 |
| UCPRC | 2,0 | 2,0 | 14,0 | 2,0 | 1,0 | | 21,0 |
| CT | | 2,0 | | 1,0 | | | 3,0 |
| Sum | 22,8 | 19,9 | 24,4 | 9 | 11 | | 87,1 |



9 REFERENCE LIST

1. European Asphalt Paving Association, "Environmental Impacts and Fuel Efficiency of Road Pavements" Industry Report March 2004
2. Regulation (EC) No 715/2007 of the European Parliament and the council of 20. June 2007 on the type approval of the motor vehicle with respect to emission from light passenger and commercial vehicles (Euro5 and 6) and on access to vehicle repair and maintenance information.
3. Ulf Hammarström, Rune Karlsson, Harry Sörensen, VTI Sverige, Road surface effects on rolling resistance – coastdown measurement with uncertainty analysis in focus. Deliverable D5 (a), Energy Conservation in Road Pavement Design, Maintenance and Utilisation. EU-project, page 1 - 7

