Michigan Ohio

University Transportation Center

Annual Report 2008-2009, Year Three

Grand Valley State University

Wayne State University

University of Detroit Mercy

The University of Toledo
1872
Intermodal Transportation Institute
UT-University Transportation Center

BGSU
Bowling Green State University

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I. Center Director's Vision Statement

The MIOH UTC serves the needs of the nation and region by completing specific educational, research, outreach and technology transfer projects. It identifies and selects such projects through processes that directly involve leaders from US DOT, MDOT, ODOT, regional agencies, and a variety of leaders from industry and academia.

MIOH is much more than a consortium of five universities. Rather, it is a full partnership of industry, government, and academia. In fact, no "advisory committee" exists; rather, industry and government leaders are participants in the MIOH Operating Committee and its three "Interest Groups" that focus on alternative energy, transportation system efficiency, and supply chains. This partnership began through three intense "focused forums" that involved over 75 leaders from industry, government, and academia. These forums yielded the initial "cut" of broad themes and recommended projects for MIOH. Separate meetings with MDOT, ODOT, FHWA and many other organizations have also created great potential for collaboration on top priorities.

As a result of these inclusive processes, as of 2008-2009 MIOH has selected 22 research, education and outreach projects many of which were initiated over the past two years. These processes and the criteria described herein, will continue to assure that all MIOH projects are of the highest quality and well focused to meet a variety of objectives:

- national impact;
- regional economic development;
- professional education;
- attraction of a larger and more diverse cohort of transportation professionals; and
- direct impact on the congestion, the environment, energy efficiency, the competitive position, and overall transportation system efficiencies in our region.

One additional aspect of MIOH that may be different than many other UTC's is the real, substantive outreach into the K-12 educational system to directly impact pre-college students' awareness, interest and preparation for careers as professionals in transportation. This program involves a partnership between faculty at the University of Detroit Mercy, high school teachers, the Ford Motor Company, and the Educational Development Corporation. This partnership yielded content, courseware, and methods that have been made available to over 400 high schools nationally. Additional K-12 outreach will continue to occur through MIOH's innovative Saturday classes and summer camps.

By the end of this four-year grant period, the MIOH UTC will be:

- a partnership of academia, government, and industry marked by uniquely open and active dialogues on challenges and opportunities leading to substantive collaborations in response to them;
- a widely recognized source of knowledge and expertise in the three MIOH focal areas *(In our first three years, MIOH research was reported in 29 publications and 32 conferences presentations)*;
- a pipeline providing a large, diverse supply of transportation professionals who, by studying at the five MIOH universities, or in joint programs provided by multiple universities, possess exceptional competencies related to transportation systems, supply chains, and alternative fuels *(In our first three years, over 110 university students participated in MIOH transportation research/education/outreach projects. In addition, 226 high school students have participated in transportation classes and summer camps.)*;
- a highly regarded source of continuing education for working professionals; and
- a catalyst for the generation of new products, services and systems that improve the economies of the MIOH region and its companies to partner and compete in the global marketplace.

When this vision is achieved, the MIOH University Transportation Center will be sustainable through continued government and foundation grants, corporate investment, tuition and fee income, and sale of intellectual property. In fact, during its first three years, MIOH achieved a 176 percent match of the US DOT funds, leveraging the DOT funds to multiply the impact of the UTC. The Year 3 match rate alone is 140 percent.

For over three years, the MIOH partners from academia, government and industry have collaborated effectively in the development of this enterprise -- and it is clearly achieving its promise. As we move forward together, we can and will create new knowledge and impact the efficiencies and effectiveness of our transportation systems thereby creating a positive economic impact. We can and will attract and educate a cadre of transportation professionals who are more able to address the opportunities of our region and the nation than their predecessors. In doing so, we can and will support the sustained and increased strength of our region and our nation.

Dr. Leo E. Hanifin
Director – MIOH University Transportation Center

II. Center Theme, Mission, and Focal Areas

MIOH UTC's Theme

Alternate energy and system mobility to stimulate economic development

MIOH'S Mission

MIOH will work to significantly improve transportation efficiency, safety, and security in Michigan and Ohio, as well as, across the nation by increasing the effective capacity of existing transportation infrastructure, reducing transportation energy dependence through alternative fuels, and enhancing supply chain performance.

This will be accomplished through:

1. the development and organization of new knowledge, technology and management systems;
2. the effective transfer of new and existing knowledge to commercial enterprises and educational communities; and
3. the development of a cadre of transportation professionals that is larger, more diverse, and better prepared to address the challenges and opportunities of 21st century transportation systems.

MIOH Focal Areas

Transportation System Efficiency and Utilization

MIOH will develop methods that meet future transportation system capacity requirements at minimum costs. To maximize the effectiveness/utilization of the current transportation infrastructure, and thereby minimize future expansion and related costs to taxpayers, MIOH will perform research, education and technology transfer to:

1. increase the utilization of existing assets through the application of technology and innovative management practices;
2. identify innovative design and operational/administrative solutions to bottlenecks and safety/security in transportation systems; and
3. improve the management and planning of maintenance and repair.

Supply Chains

MIOH will focus on the transportation, logistics and distribution aspects of the supply chain and the interactions between supply chain participants through improved inter-modal connectivity and system-wide efficiency. These efforts will enhance our region's competitive position in the global economy and expand job opportunities. Efforts will:

1. improve supply chain performance through the application of technology and innovative management practices;
2. identify innovative design and operational/administrative solutions to transportation system bottlenecks as they impact supply chains; and
3. improve the security and reliability of the supply chain.

Alternative Fuels

MIOH will develop affordable alternate sources of energy for vehicles and methods to distribute fuels throughout the transportation network, yielding improvements in both security and the efficiency of transportation.

III. Partner Universities

University of Detroit Mercy
Detroit, Michigan
(Lead Institution)
www.udmercy.edu

Bowling Green State University
Bowling Green, Ohio
www.bgsu.edu

Grand Valley State University
Grand Rapids, Michigan
www.gvsu.edu

University of Toledo
Toledo, Ohio
www.utoledo.edu

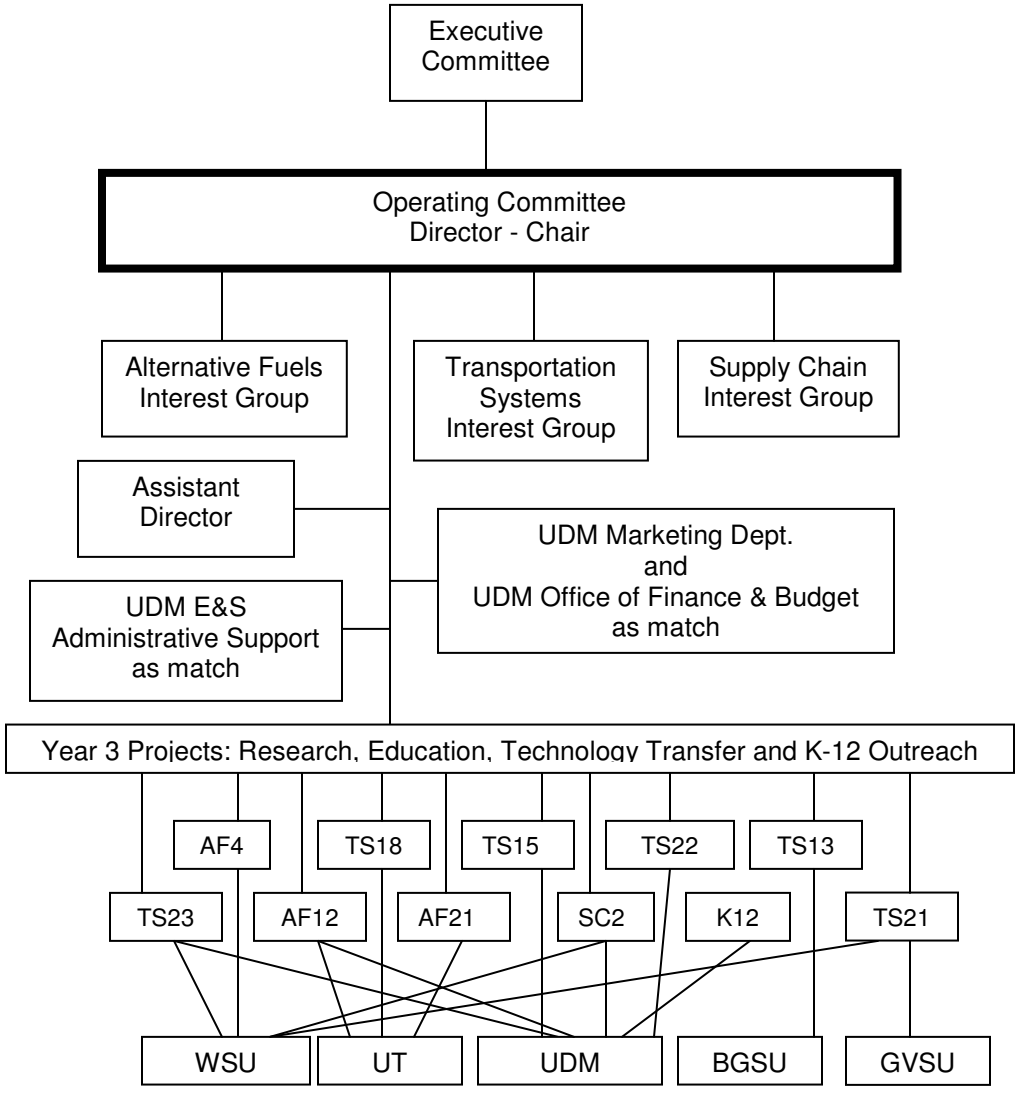
Intermodal Transportation Institute
UT-University Transportation Center

Wayne State University
Detroit, Michigan
www.wayne.edu

IV. Management Structure

The MIOH UTC's management approach is one that is open and inclusive of all partners, both at the five MIOH universities and its partner corporations and government agencies. The MIOH organization, summarized in the graphic below, reflects that approach. It does not have an "advisory committee" that is separate from the decision-making groups of the UTC. Rather, all university, corporate, and government representatives serve on interest groups and/or the MIOH Operating Committee to stimulate, identify, and review project proposals in addition to developing and approving the MIOH annual program plan and budget.

A. Organizational Chart



B. Principal Center Staff

Dr. Leo E. Hanifin is Director of the MIOH UTC and Dean of the College of Engineering and Science at UDM. In addition to considerable industrial experience, Dr. Hanifin has extensive experience leading research centers, research and educational coalitions and engineering education.
Contact: hanifinl@udmercy.edu, Ph: 313-993-1216, Fax: 313-993-1187.

Patricia Martinico joined the UTC in the fall of 2006 as Assistant Director. Ms. Martinico's background includes administrative experience as Assistant Dean of Architecture at UDM, as well as corporate event planning for a Michigan destination management company. In addition, she holds graduate degrees in business and economics.
Contact: martinpa@udmercy.edu, Ph: 313-993-1510, Fax: 313-993-1187.

C. Executive Committee, Operating Committee, and Interest Groups

Executive Committee, **Year 3** as of August 31, 2009

University	Member
BGSU	**Deanne Snavely**, Interim Vice Provost for Research and Dean of the Graduate College
GVSU	**Paul Plotkowski**, Dean of Engineering and Computing (alt. H. James Williams, Dean, Business)
UDM	**Pamela Zarkowski**, Academic Vice President
UT	**Frank Calzonetti**, Vice President for Research Development
WSU	**Mumtaz Usmen**, Interim Dean of Engineering
MIOH UTC	**Leo Hanifin,** UTC Director and Dean of Engineering and Science, UDM (ex officio)

Operating Committee, **Year 3** as of August 31, 2009

Leo Hanifin	UTC Director
Hokey Min	Faculty Representative BGSU
Charles Standridge	Faculty Representative GVSU
Utpal Dutta	Faculty Representative UDM
Rich Martinko	Faculty Representative UT
Snehamay Khasnabis, alt. Mumtaz Usmen	Faculty Representative WSU
James Merritt	US DOT – R & D Program Mgr, Pipeline Safety
Kirk Steudle, alt. Niles Annelin	MDOT – Director
Jim Saber, alt. Roland Kibler	NextEnergy – Director, Program Development
Carmine Palombo	SEMCOG -- Director, Transportation
Warren Henry	TMACOG -- Vice President for Transportation

Alternate energy and system mobility to stimulate economic development.

Interest Groups, Year 3 as of August 31, 2009 (7-12 members each)
Operating Committee Members may also participate in interest group(s).

Alternative Energy

Roland Kibler	Manager, Technology Development, NextEnergy
Mark Schumack	Faculty, Mechanical Engineering, UDM
Snehamay Khasnabis	Faculty, Civil Engineering, WSU
Barry Piersol	Assistant to the Dean, College of Technology, BGSU
John Wilson	Energy Tech Consultant, TMG / Energy
Scott Staley	Director, Hybrid and Fuel Cell, Ford Motor Company
Patsy Muzzell	Team Lead (Acting), Assured Fuels Initiative U.S. Army TARDEC, National Automotive Center (alt. Eric Sattler)

Transportation Systems

Carmine Palombo	Director of Transportation, SEMCOG
Ralph Robinson	Co-Lead UMTRI's Transportation Systems Group
Charlie Standridge	Professor, College of Engineering and Computing, GVSU
Utpal Dutta	Professor, Dept. of Civil Engineering, UDM
Mumtaz Usmen	Chair, Dept. of Civil Engineering, WSU
Barry Piersol	Asst. to the Dean, College of Technology, BGSU
Pete Lindquist	Chair, Dept. of Geography & Planning, UT
Greg Krueger	MDOT, Director – Intelligent Transportation Systems
Lou Lambert	Consultant
Steve Underwood	Center for Automotive Research
Richard Beaubien	Associate, Hubbell, Roth & Clark, Inc.

Supply Chain

Chip Napier	Metro Detroit District Engineering Manager, UPS
Thomas Madden	Supply Chain Management, General Motors
John Drury	Leader – Supply Chain Network Optimization Team, IBM
John Taylor	Faculty, Business, WSU
Hokey Min	Faculty, BGSU
Shahram Taj	Faculty, Business, UDM
Ratna Chinnam	Faculty, WSU
Paul Hong	Faculty, UT
Tim Buckel	Metro Detroit Engineering Manager, UPS
Niles Annelin	MDOT – Transportation Planning
Gene Robinson	Director of Automotive Glass Technology, Libby-Owens-Ford
S. Manivannan	Supplier Development Leader - Black Belt, Rolls-Royce N. America
Terry Onica	Director, Automotive Marketing, QAD
John Daly	Manager – Director, Genesee County Road Commission

V. Overview of Education, Research, and Technology Transfer Programs

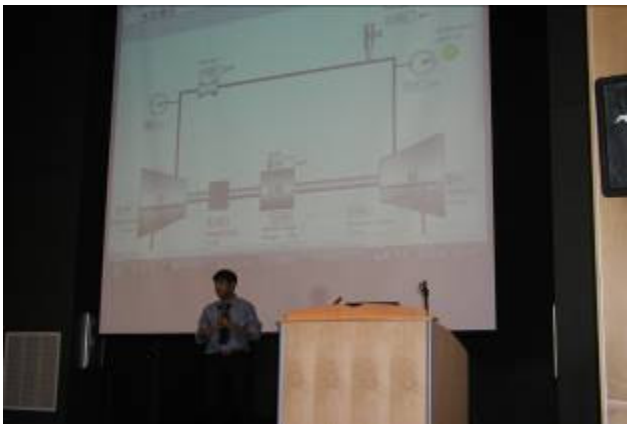
A. MIOH Education Program

During its third year, the MIOH UTC posted educational modules on its website resulting from two projects. New projects included four at the pre-college level:

1. Multi-purpose Educational Modules to Teach Hydraulic Hybrid Vehicle Technologies to Undergraduate Engineering Students (AF1, Project 3, Yr2)

The educational modules and computer simulation software developed throughout this project is available on the internet for other universities to adopt at

http://mioh-utc.udmercy.edu/education/af-1/material/index.htm



The project team including four faculty and three students from The University of Toledo (lead) and the University of Detroit Mercy developed education modules and educational simulations that employ a dual-function hydraulic pump/motor test stand. The resulting experiments and simulations formed complete modules to teach engineering students fundamental concepts of the hydraulic hybrid vehicle technology. These modules can be employed in core courses of the mechanical engineering curriculum. As such, these modules can be used to enhance the students' learning in fluid dynamics, hydraulics, energy systems, vibrations, mechatronics and controls. This simulation will also enable students to compare the performance of various hybrid configurations with conventional IC engines. Additionally, the investigators have presented and published their educational findings at conferences and in educational journals.

2. Ford PAS Alternate Fuels Module for High School Students (K12-1, project 4, Yr3)

The modules have been provided to the Ford PAS Program and been posted on the UDM and Ford PAS websites for free download and use by any high school nationally. ***http://eng-sci.udmercy.edu/pre-college/alt_fuel_curriculum/***

Five UDM faculty members (2 mechanical engineering, 2 biology, and 1 chemistry) developed hands-on alternative fuels modules that can be integrated into high school curricula across the nation as part of the Ford Partnership for Advanced Studies (PAS). In all, sixteen activities involve a wide variety of experiences for students: making biodiesel, comparing parameters of biodiesel and ethanol, operating a simulation model to examine fuel economy, and learning basic chemistry and/or biology related to combustion, greenhouse gas production, production of biofuels and hydrogen, and alternatives for vehicular propulsion.

The availability of these teaching modules has been communicated by postcard, email or mailed CD to: Ford PAS network of schools (approx. 400 nationwide), 35 Detroit

public schools using Detroit Area Pre-College Engineering Program (DAPCEP) in-school curriculum, 200 high schools in the Metropolitan Detroit area, the Michigan homeschools network, Girl Scouts and Boy Scouts Metro-Detroit Office.

3. Alternative Fuels DAPCEP Class for High School Students (K12-2, project 3, Yr3)

For a third year, Mechanical Engineering faculty offered a five-week Saturday class through Detroit Area Pre-College Engineering Program (DAPCEP). The course, *Powering the Car of Tomorrow,* was developed by members of Chemistry, Biology and Mechanical Engineering. Activities covered Internal Combustion Engines, Making Biodiesel, Testing Biodiesel, Measuring Energy Content, Building a Fuel Cell Car, and Comparing Fuel Alternatives. This course also allowed faculty members to refine educational content incorporation in the Ford PAS modules (described above). Nineteen students participated in this course.

4. Transportation Summer Camp for High School Students (K12-3, project 3, Yr3)

TRANSIT, a one week summer camp, was conducted for the third year by Civil and Environmental Engineering faculty members from UDM.

It included presentations and hands-on activities by professionals from the following organizations:

- Southeastern Michigan Council of Governments, Traffic Division
- The Road Commission of Oakland County
- The Detroit Collaborative Design Center (UDM, School of Architecture)
- Michigan Department of Transportation
- Ford Motor Company
- Spalding DeDecker

Activities focused on intelligent transportation systems, paving systems, urban planning/transportation, Vehicle Infrastructure Integration, traffic signals/controls, and regional transit systems. Thirteen students participated in the camp.

5. STEPS Camp (Science Technology and Engineering Preview Summer Camp for Girls) (K12-14, project 2, Yr3)

The STEPS Camp at UDM is a five-day residential program for high school girls designed to:

- introduce young women to manufacturing, engineering, science, math and robotics;
- increase their interest in a career in one of these areas;
- provide them with a positive university experience;
- provide exposure to college professors and students, and professional engineers;
- improve their perception of engineering; and
- inspire young women to consider a career in manufacturing, engineering or science.

Activities included academic, social and personal reflection. The main project, included a *Robotics Challenge* based on the LEGO Mindstorm NXT system, which was revised in 2008 to include a transportation theme thanks to financial support from the UTC. The campers also participated in academic labs such as Batteries, Programming, Sensors, Circuits, Welding, Fuel Cells, Motors, and Engineering Math. STEPS 2009 was the camp's eighth year. It was the second to have a transportation theme integrated into its activities. The camp was conducted with a total of 38 girls participating.

(Excerpt from Campers' Newsletter)
"Some of the lessons we learned at camp include:

Don't give up on your dreams just because they are hard to accomplish.
Get exposed to lots of different types of work and activities.
Don't let anyone tell you that "you can't do it".
Be flexible and open-minded.
Stay true to yourself and keep your integrity.
Take the hard classes in high school... especially math.
Don't shut any doors. Engineering opens all kinds of opportunities for you."

B. MIOH Research Program

During its third year, the MIOH UTC defined and launched four new research projects and funded five projects to continue. Of the new projects, one involves alternative fuels and three involve transportation systems. All focus on important national priorities including independence from foreign oil, efficient freight delivery, and congestion mitigation.

1. Improved Oxidative Stability of Biodiesel Fuels (AF4, project 4, Yr3)

As a four year research effort, a team of two faculty members and their graduate students from Wayne State University, in cooperation with the National Biofuels Energy Laboratory at NextEnergy in Detroit, are investigating the effect of antioxidants on the stability of different types of biodiesel; additionally, they are studying the long-term stability of biodiesel with synthetic/natural antioxidants. A goal is to develop/evaluate commercial antioxidants to improve the oxidative stability of biodiesel and make it a viable alternative fuel. These on-going research phases are anticipated to continue through 2010.

As of summer 2009, the long-term stability for soybean based biodiesel with or without 1000 ppm synthetic/natural antioxidants stored at room temperature for 30 months was evaluated. Results indicate that the oxidative stability of untreated SBO-based biodiesel significantly decreases as a function of time, while the addition of the antioxidant TBHQ can improve and maintain oxidative stability up to 30 months.

TBHQ:PY and TBHQ:BHA, binary blends of antioxidants, were studied for indoor and outdoor long-term stability on soybean based and poultry fat based biodiesel. Results show that these binary blends of antioxidants can improve the oxidative stability of biodiesel significantly and the TBHQ: BHA blend produced the best antioxidant synergism. The 6-month stability results suggest that biodiesel with TBHQ: BHA remains oxidatively stabile through the time period.

Metallic contaminants in the ppm level were proven to be detrimental factors of the oxidative stability of biodiesel. The greatest level of instability was brought by Cu contamination, as low as 1 ppm can decrease the oxidative stability by around 60%. To address metallic contamination, Citric acid metal chelator was found to counteract the effect of the contaminants at a comparable loading. The results are being reported through scholarly publications and conference presentations.

2. Enabling Congestion Avoidance and Reduction in the Michigan-Ohio Transportation Network to Improve Supply Chain Efficiency (SC2, project 4, Yr3)

Three faculty members and four students from Wayne State University (lead) and the University of Detroit Mercy are developing efficient dynamic freight routing algorithms under both recurring congestion and non-recurring incidents by using real-time ITS traffic information. These routing models include anticipatory modeling of recurring congestion and modeling of reactive and anticipatory traffic flow behavior in response to non-recurrent congestion. One of the key aspects of this work is that its scalability enables

implementation in real highway systems for dynamic rerouting of freight. In today's automotive plants, 80 percent of all parts are delivered to assembly plants JIT (just-in-time) with only three hours of inventory on site. Targets for supply chain efficiencies are becoming even more aggressive. As such, these plants' operations have become susceptible to traffic congestion delaying delivery trucks causing part shortages and shutdowns of assembly operation.

This team also includes active participation from UPS, Ford Material and Logistics, C.H. Robinson, the Michigan Department of Transportation (MDOT) ITS Office, and Michigan Intelligent Transportation Systems (MITS) Center.

The researchers developed stochastic models and algorithms for efficient solution of routing problem with non-stationary recurrent and non-recurrent congestion. They have implemented these models for the SE Michigan network and tested for accuracy and performance. These results were presented at the INFORMS Annual Conference in San Diego on 13 October 2009 as an invited presentation under the Transportation and Logistics cluster. The researchers also presented at the "The Third International Workshop on Intelligent Vehicle Controls & Intelligent Transportation Systems - IVC & ITS 2009" Milan, Italy.

Further, the research team has also developed, tested and validated the milk-run delivery models and algorithms using real time ITS information which are critical to some of the logistics companies and their partners such as Ford MP&L. This achievement represents a major contribution for it exploits real-time traffic information during multi-leg vehicle routing and identifies the most robust customer/supplier stop sequence. The Researchers are currently working on building the business case for their collaborator Ford to use the models.

3. Improving the Energy Density of Hydraulic Hybrid Vehicles (HHVs) and Evaluating Plug-In HHVs (AF12, project 2, Yr3)

A team from the UT and UDM continues research for a second year. Hydraulics (often called fluid power) offers the best solution for hybridizing heavier vehicles such as SUVs, trucks, and buses to improve fuel economy. Using conventional gasoline engines under a parallel hybrid, US EPA/NVFEL testing and modeling programs project a 34% fuel economy improvement for a large four wheel drive SUV. This research project aims at addressing one of the main limitations of hydraulic hybrid vehicles (HHVs). These hybrid vehicles capture the otherwise-wasted energy in "mechanical batteries" (hydraulic accumulators). The hydraulic accumulators allow for rapid charging and discharging, which translates to very high power density in hydraulic hybrid vehicles. This feature is the main benefit of these vehicles over electric hybrids. On the other hand, the energy density of the HHVs is limited by the amount of fluid that can be stored in the high pressure accumulators.

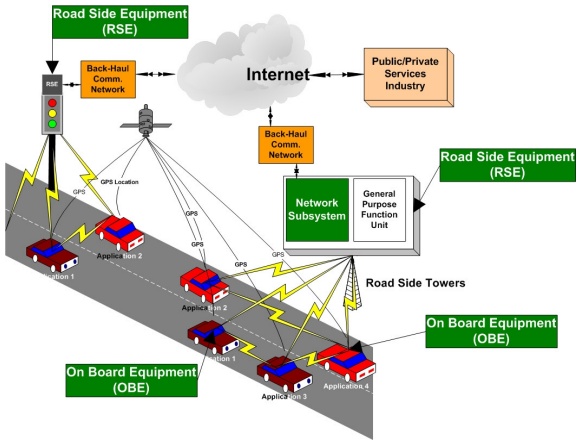
In this phase of the research a new concept is being evaluated through analysis, simulation, and experimentation to address the energy density limitation of the hydraulic hybrid vehicles. A compressed air reservoir is being integrated into the hydraulic hybrid system. In addition to improving the energy density and providing longer operation for the vehicle, this new system will provide the electric plug-in capability for HHVs.

The research group continues working on the model to incorporate control algorithms during the second year of the project. The UT Simulink model has been developed. The air system as designed was determined to be unfeasible.

UDM researchers completed a series of calculations that validate UT's conclusions about the impracticality of the air system as originally designed. Researchers also analyzed the "plug in" feature of the design; i.e., the capability to recharge the air tank with an electric compressor. The analysis shows that a fully recharged tank provides minimal assist under the current configuration. The researchers subsequently altered the design to eliminate the "pressure exchangers," powering solely by a hydraulic motor, and found the range of the vehicle to be significantly improved (considering the air/hydraulic system as the only propulsion system). The new design shows some promise with a small vehicle traveling about 45 miles on a single air-tank charge.

4. New Approach to Enhance and Evaluate the Performance of VII and ITS Communication Systems (TS15, project 2, Yr3)

Partnering with the Center for Advanced Research (CAR), a team of two faculty members and three graduate students at the University of Detroit Mercy began to undertake development of a test bed that allows the testing of different inter-vehicle communication protocols. The test bed provided a tool to evaluate message delay and channel throughput. Additionally, it facilitated investigation of real-world, inter-vehicle communication scenarios with actual vehicles.



The test bed has been developed to evaluate the performance of the most commonly used protocols (IEEE 802.11 family).

The researchers have designed an indoor and outdoor set of experiments to study the impact of distance between vehicles on the performance of wireless communication channel under different conditions. The performance measures used are the communication range, time-to-login, throughput, jitter time, delay time, and Signal to Noise Ratio (SNR). The outdoor experiment has been designed to acquire data samples from a real-world scenario at the Michigan International Speedway racing track located in Brooklyn, Michigan.

The researchers developed a simulation model using MATLAB/SIMULINK to evaluate the impact of vehicle speed on frequency of a transmitted signal, known as Doppler shift effect. The developed model simulates a wireless channel as an integration of two popular channel models; Additive White Gaussian Noise (AWGN) channel and Multipath Rayleigh Fading channel. Consequently, vehicle speed varied and resulting Bit Error Ratio (BER) values were recorded and plotted. The researchers are working to investigate the impact of Doppler shift effect on possible data loss.

The project requires a traffic/network simulation environment that is fully supported and can simulate the desired scenarios. After evaluating several traffic/network simulation tools, work is moving forward with VNSim. VNSim was developed in collaboration between the Technical University of Buchares and Rutgers. The researchers are evaluating this simulation environment to determine its suitability to simulate different traffic light scenarios.

As a result of this research, the researchers have submitted a paper to ITS-America 2010 (ITSA-2010) and presented four poster sessions; two at the University of Detroit Mercy Faculty and Student Research Symposium and two at the ITS-Michigan Annual Meeting and Exposition (2008 and 2009).

5. Transportation Informatics: Advanced Image Processing Techniques for Automated Pavement Distress Evaluation (TS18, project 2, Yr3)

A research team at The University of Toledo partnered by the University of Detroit Mercy continues the effort that investigates the designing an automatic and non-destructive evaluation pavement inspection system using advanced image processing techniques. Specifically, this project deals with the development of algorithms to detect and classify surface cracks from pavement images. The proposed method for crack detection involves a number of steps including removal of non-uniform illumination, non-linear filtering, segmentation using thresholding, and morphological operations. After segmentation of the image, the regions corresponding to crack areas are identified and represented by a matrix of square tiles. Since the crack pattern can be represented by the distribution of the crack tiles, standard deviations of both vertical and horizontal histograms are calculated to map the cracks into a 2D feature space. The types of cracks, namely, longitude cracks, transverse cracks, block cracks and alligator cracks are then identified from the 2D feature space. This new technique provides a low-cost, near real-time distress analysis option through a series of image processing techniques. The experimental results, obtained by testing real pavement images over local asphalt roads, present the enhanced effectiveness of the algorithm for automating the process of identifying road distresses from images.

6. Characterization and Speciation of Fine Particulate Matter Inside the Public Transport Busses Running on Bio-Diesel (AF21, project 1, Yr3)

A research team at The University of Toledo composed of one faculty and one doctoral student undertook to physically and chemically characterize the fine particles collected inside Toledo Area Regional Transportation Agency (TARTA) public transit buses fueled by bio-diesel meeting the ASTM 6751 standard.

This project was focused on monitoring, collecting, and analyzing the particulate matter inside the buses. For this purpose, two buses in the TARTA fleet were chosen. One was fueled by ultra low sulfur diesel and another one was fueled by biodiesel blend. The sampling was performed with the help of the GRIMM sampler and Sioutas Cascade Impactor. The study profile included the above two buses in two seasons. Results of particulate matter level suggest that air quality is healthful in terms of carcinogenic compounds i.e. PAHs. Scanning electron microscope analysis was helpful in understanding the origin of particulate matter level. The interpretations of results bring attention to several noteworthy issues. These issues are briefly presented:

1. The levels of particulate matter were found well below the guideline values.
2. There is a definite distinction between particulate pollution level inside and outside of the buses.
3. The Polycyclic Aromatic Hydrocarbon levels were found absent in particulate phase, which ensures healthful air inside the bus.
4. SEM analysis helped researchers determine the possible sources of particulate matter inside the bus.

The shape, size distribution analysis, and aspect ratio will help in determining the potential particle deposition in the lungs, as well as understanding particle dynamics inside the bus.

7. Management and Analysis of Michigan Intelligent Transportation Systems Center Data with Application to the Detroit I-75 Corridor (TS21, project 1, Yr3)

The major and primary contribution of this project is to describe, explain, and predict the flow of traffic in a corridor with respect to time and space as well as to apply these results in the routing of traffic. The results of this project are targeted at ITS systems that seek to reduce congestion by better routing large volumes of traffic at a small time interval as opposed to PTA's that route one vehicle at a time.

The project is organized around three subprojects. The first of these is the statistical modeling and analysis of traffic data from the Michigan Intelligent Transportation Systems Center (MITSC) in Detroit for the purpose of describing, explaining and predicting the flow of traffic. As a part of her masters thesis, Georgescu (2009) developed descriptive, explanatory, and predictive statistical models of traffic speed. Descriptive models are graphs that show speed and traffic volume over time for each day of a one year period, from November 2006 through October 2007. Regression was used to construct explanatory and predictive models. Future speed was predicted as a function of yearly average speed, and the previous two speeds for an interval of up to 30 minutes. The coefficients of the regression equation where estimated using regression equations as a function of the prediction time. The relative mean prediction error ranged from 5% to 10%.

The second subproject dealt with computer-based models for re-routing large volumes of traffic around an incident with both software and hardware based solvers. We believe this model to be unique, since existing routing algorithms are designed for routing a single vehicle and do not consider the consequences of re-routing a large number of vehicles in a relatively short span of time. The model includes the idea that the selected route may change because of the volume of previously re-routed traffic. The model considers multiple types of vehicles separately, such as cars and trucks as well as multiple concurrent traffic incidents. A traffic corridor is modeled in the usual way as a set of nodes and arcs. Each arc represents a segment of a highway, an arterial road, or a street. The metric associated with each arc is computed each time it is needed and may be a function of any variable: time, volume of traffic, arc capacity, type of vehicle and the like. The traffic corridor surrounding southbound I-75 in Detroit was modeled and data available from MDOT was employed. The model includes a traffic simulator to predict the volume increase in any arc due to re-routing.

The third subproject has to do with the development of traffic simulation models for validating the results produced by the re-routing models. An analytic framework for the calibration and application of a micro-simulation model (AIMSUN) for validating the

effectiveness of alternate incident management strategies (IMS's) on an urban transportation network was developed. This framework was demonstrated through the modeling of the I-75 corridor in Detroit area. The model was calibrated and its application demonstrated.

8. Crash Benefits of SCATS Control System (TS22, project 1, Yr3)

Two faculty and two students are undertaking research to determine the effectiveness of the Sydney Coordinated Adaptive Traffic System (SCATS) in reducing traffic hazard by examining crash rate as Measure of Effectiveness (MOE). The performance of a test corridor (a corridor that has been converted to the SCATS system) and a control corridor (a corridor that has not been converted to the SCATS system and operates under conventional signal control) are being compared for various measures of effectiveness. In addition, a cost-benefit analysis of the SCATS system will be performed by considering congestion and crash benefits, installation/maintenance cost and life span.

Project meetings and discussions with representatives of SEMCOG and RCOC have resulted in selection of a test corridor as the Pre-timed Signal Corridor to be studied: Dixie Highway from US 24 to I-75. Site visits, traffic volume, and land use were also considered in the selection. Crash and traffic volume data for a 6.186 mile segment of M-59 were collected. Predominant crash severity type before and after the installation of the SCATS system were identified. Crash rate for segment as well as intersections were computed.

Proportion of Severity over total crashes were determined. Statistical tests on proportionality were conducted to determine significance. . The findings of this study will be documented into a final report within next few months.

9. Transit Oriented Development at Selected LRT Stations in the Detroit Metropolitan Area (TS23, project 1, Yr3)

A team lead by WSU researchers with partners at UDM are conducting a study to develop programs for Transit Oriented Development (TOD) at two potential station sites along the Woodward Avenue planned LRT route in the Detroit metropolitan region. This study proposes to develop different TOD packages for these sites and to identify planning, economic and institutional mechanisms for their effective implementation.

As a part of selecting candidate stations, the project team analyzed transportation and land use characteristics of different station areas on Woodward corridor, and reviewed relevant literature to identify factors that may be considered conducive to transit-oriented development. During the summer of 2009, the project team selected two stations for TOD application based on travel, land use and demographic characteristics. Detailed analyses of these stations areas is nearing completion. Meetings were held with city personnel and other experts to gain additional insights.

The implications of some recent developments, e.g. a grant awarded to the cities of Troy and Birmingham for the proposed intermodal transit center on one of the candidate sites, and proposals for new development at the other candidate site are being considered for the study. During the coming months, the project team will concentrate on an analysis of different institutional mechanisms to promote development, and on the preparation of the final report.

C. MIOH Technology Transfer Program

The MIOH UTC has developed a three-tier strategy for technology transfer that involves direct transfer, UTC-wide activities, and partnering with established organizations.

Direct Transfer

The MIOH UTC is engaged in technology transfer on a direct basis. That is, all projects involve direct participation of corporations and/or government agencies that can directly benefit from and employ the results of the project. Some of the participants are the Michigan Department of Transportation, Ford Motor Company, NextEnergy, UPS, Michigan Intelligent Transportation System (MITS) Center, Detroit Area Pre-College Engineering Program, the Road Commission for Oakland County, the Toledo Metropolitan Area Council of Governments, Ryder, Deloitte Consulting and the Southeast Michigan Council of Governments. Through direct participation in projects, these organizations not only influence the efforts but also prepare themselves to quickly transfer results into improved transportation systems and transportation education.

UTC Wide Activities / Partnered Technology Transfer Events

Moving Toward Deployment: New Knowledge for ITS Practitioners, July 29, 2009

The summer meeting of the Intelligent Transportation Society Michigan (ITS-Michigan) was co-hosted by the MIOH UTC on the campus of the University of Detroit Mercy on July 29, 2009. Members, practitioners, faculty researchers, and students began the day hearing the most recent results of projects funded through the UTC.

Following the morning presentations the audience self-selected into break-out discussion groups addressing the following concept: "To focus, enable and accelerate the creation and implementation of new IntelliDrive technologies leading to benefits to the people and the economy of Michigan." Three break-out action areas were identified: A.) Technologies Push; B.) Market and Community Pull; and C.) Barriers to Seamless Collaboration.

At the conclusion of the ITS Michigan meeting, Dr. Peter Savolainen, WSU, presented a newly constructed Vehicle Infrastructure Integration (VII) course entitled. This course is a collaborative effort by faculty at Wayne State University and the University of Detroit Mercy. It will educate potential stakeholders including public agencies, elected officials, private corporations and the traveling public. This power point course with slides and notes is available on the MIOH UTC website at: *http://mioh-utc.udmercy.edu/education/intelli_drive/index.htm*

As the ITS Michigan meeting coincided with TRANSIT Camp, at the end of the day members of the Intelligent Transportation Society of Michigan came to meet these "future transportation professionals". Campers had the opportunity talk "one on one" about opportunities and realities with working transportation professionals.

Alternative Energy Forum Research and Results, April 8, 2009

The 2009 alternative Energy Technology Transfer Forum presented ongoing research and early results from projects at three universities and two corporations. Featured speakers included:

- Oliver F. Baer, President and Cofounder, Clean Emission Fluids, Inc.
- Dr. Haiying Tang, Research Asst. Professor, Chemical Engineering WSU
- James A. O"Brien, II, Founder, Chairman of the Board, Chief Technology Officer, Hybra-Drive Systems, LLC.

The Michigan Ohio UTC and NextEnergy co-sponsored the forum held at NextEnergy on April 8, 2009.

Poster Sessions

Four student researchers from partner universities were selected to present poster session at the 2009 Annual Summer meeting of the Intelligent Transportation Society of Michigan.

Sabyasachee Mishra, as a doctoral candidate at Wayne State University was selected to present a poster session entitled "Incident Management Strategies for Urban Freeways and Arterials". Last year Mishra won the 2nd prize for the Institute of Transportation Engineers (ITE) Great Lakes District (Indiana, Michigan, and Ohio) Student Award for his paper "A Micro Simulation Model Application for Incident Management Strategies" in 2008. Mishra completed his Ph.D. under the direction of Dr. Snehamay Khasnabis in the WSU Department of Civil and Environmental Engineering in 2009.

Ms. Luana Gergescu, a masters student at Grand Valley State University in the School of Engineering pursuing research under the direction of Dr. Dave Zeitler and Dr. Charles Standridge, was selected to present a poster session entitled "Descriptive Modeling of ITS Traffic Flow Data".

Khaldoun Albarazi, a graduate Electrical Engineering student at the University of Detroit Mercy, presented a poster session entitled "Next Generation Traffic Light System". Baraa Alyusuf, a graduate Electrical Engineering student at the University of Detroit Mercy, presented a poster entitled "Performance Evaluation of IEEE802.11 Family Protocols. Both graduate students are currently involved in research with Dr. Nizar Al-Holou.

Future Plans

Planned in 2010, the MIOH UTC will again partner with NextEnergy to co-sponsor technology transfer project presentations at those facilities focused on alternative fuels. Also a meeting at partner Grand Valley State University is planned for presentations of their research in progress. These events will be promoted by the MIOH UTC and partner organizations.

2008 MIOH UTC Student of the Year

Laurel VandePutte, UDM completed a Master of Engineering in 2009.

Right: Laurel receives US DOT award at the CUTC banquet in Washington DC.

Below: Laurel receives MIOH UTC award at a gathering of Walbridge colleagues at her employer's offices, Detroit, MI.

VI. Examples of Specific MIOH UTC Accomplishments – Year 3

The following are some examples of specific accomplishments that support the national strategy for surface transportation research and/or respond to DOT priorities.

- **K-12 educational models and courseware** has been further developed, piloted, assessed and distributed. This included two summer camps, one Saturday program and courseware developed for teacher use in a variety of high school courses. The most extensive dissemination of curriculum occurred for the **Ford PAS Alternate Fuels Modules for High School Students,** developed by five faculty members from the University of Detroit Mercy. These modules include sixteen activities involving a wide variety of experiences for students: making biodiesel, comparing parameters of biodiesel and ethanol, operating a simulation model to examine fuel economy, and learning basic chemistry and/or biology related to combustion, greenhouse gas production, production of biofuels and hydrogen, and alternatives for vehicular propulsion. ***These teaching modules have been communicated by postcard, email or mailed CD to over 600 high schools across the nation and to all UTC's in attendance at the January 2010 CUTC meeting. They are available free of charge at: http://eng-sci.udmercy.edu/pre-college/alt_fuel_curriculum/***

- **Oxidative Stability of Biodiesel:** A team of researchers at Wayne State University has investigated the oxidative stability of different types of biodiesels and blends and the results of long-term indoor and outdoor storage, and the impact of antioxidants on biodiesels from various feed-stocks. Their work during the past year yielded three significant results:

  1. The oxidative stability of untreated Soybean-based biodiesel significantly decreases as a function of time, while ***the addition of the antioxidant TBHQ can improve and maintain oxidative stability up to 30 months.***

  2. Binary blends of antioxidants can improve the oxidative stability of biodiesel significantly and the TBHQ: BHA blend produced the best antioxidant synergism. ***The 6-month stability results suggest that biodiesel with TBHQ: BHA remains oxidatively stabile through the time period.***

  3. Metallic contaminants in the ppm level were proven to be detrimental factors of the oxidative stability of biodiesel. The greatest level of instability was brought by Cu contamination, as low as 1 ppm can decrease the oxidative stability by around 60%. ***To address metallic contamination, Citric acid metal chelator was found to counteract the effect of the contaminants at a comparable loading.***

- **Improving the Energy Density of Hydraulic Hybrid Vehicles (HHVs) and Evaluating Plug-In HHVs :** In this two year project, researchers from the University of Toledo (UT) and University of Detroit Mercy (UDM) have evaluated a new concept for improving energy density and extending operation distance for HHV's by incorporating a compressed air reservoir. During the past year the UT developed a Simulink model and it was validated by UDM researchers. Researchers also analyzed the "plug in" feature of the design; i.e., the capability to recharge the air tank with an electric compressor. The analysis shows that a fully recharged tank provides minimal assist under the current configuration. The researchers subsequently altered the design to eliminate the "pressure exchangers." This new

configuration powering solely by a hydraulic motor was found to significantly improve the range of the vehicle (considering the air/hydraulic system as the only propulsion system). ***The new design shows some promise with a small vehicle traveling about 45 miles on a single air-tank charge.***

- **Congestion Avoidance to Improve Supply Chains:** During the past year the team of MIOH researchers, from Wayne State University and the University of Detroit Mercy, developed stochastic models and algorithms for efficient solution of routing problem with non-stationary recurrent and non-recurrent congestion. They have implemented these models for the SE Michigan network and tested for accuracy and performance. These results were presented at the INFORMS Annual Conference as an invited presentation and at the "The Third International Workshop on Intelligent Vehicle Controls & Intelligent Transportation Systems - IVC & ITS 2009."

  Further, the research team has also developed, tested and validated the milk-run delivery models and algorithms using real time ITS information which are critical to some of the logistics companies and their partners such as Ford. This achievement represents a major contribution for it exploits real-time traffic information during multi-leg vehicle routing and identifies the most robust customer/supplier stop sequence. ***The researchers are currently working on building the business case for their collaborator Ford to use the models.***

- **Advanced Image Processing Techniques for Automated Pavement Distress Evaluation:** A research team at the University of Toledo partnered by the University of Detroit Mercy has developed algorithms to detect and classify surface cracks from pavement images. The proposed method for crack detection involves a number of steps including removal of non-uniform illumination, non-linear filtering, segmentation using thresholding, and morphological operations. After segmentation of the image, the crack pattern can be represented by the distribution of the crack tiles, and standard deviations of both vertical and horizontal histograms are calculated to map the cracks into a 2D feature space. The types of cracks, namely, longitude cracks, transverse cracks, block cracks and alligator cracks are then identified from the 2D feature space. ***This new technique provides a low-cost, near real-time distress analysis option*** through a series of image processing techniques. The experimental results, obtained by testing real pavement images over local asphalt roads, present the enhanced effectiveness of the algorithm for automating the process of identifying road distresses from images.

- **Management and Analysis of Michigan Intelligent Transportation Systems Center Data with Application to the Detroit I-75 Corridor:** The overriding objective of this project is to describe, explain, and predict the flow of traffic in a corridor with respect to time and space and to apply these results in the routing of traffic. ***The results of this project can be employed by ITS systems that seek to reduce congestion by better routing large volumes of traffic at a small time interval as opposed to PTA's that route one vehicle at a time.*** The following summarizes the key findings of subprojects:

  1. Regression was used to construct explanatory and predictive models through which future speed was predicted as a function of yearly average speed, and the previous two speeds for an interval of up to 30 minutes.

2. Computer-based models were developed for re-routing large volumes of traffic around an incident with both software and hardware based solvers which consider the consequences of re-routing a large number of vehicles in a relatively short span of time. The traffic corridor surrounding southbound I-75 in Detroit was modeled and data available from MDOT was employed.

3. Traffic simulation models were developed for validating the results produced by the re-routing models. An analytic framework for the calibration and application of a micro-simulation model (AIMSUN) for validating the effectiveness of alternate incident management strategies (IMS's) on an urban transportation network was developed. This framework was demonstrated through the modeling of the I-75 corridor in Detroit area.

- **Transit Oriented Development at Selected LRT Stations in the Detroit Metropolitan Area:** A team lead by WSU researchers with partners at UDM are conducting a study to develop programs for Transit Oriented Development (TOD) at two potential station sites along the Woodward Avenue planned LRT route in the Detroit metropolitan region. The project team selected two stations for TOD application based on travel, land use and demographic characteristics and completed detailed analyses of these stations areas. This study is developing different TOD packages for these sites and identifying planning, economic and institutional mechanisms for their effective implementation. (Note: ***The initial plan for Phase I of the Woodward Ave. light rail project was created though a MIOH UTC project.*** It recently received a $25 million in TIGER funds from FTA that will complement the private, state and local commitments, enabling construction to begin by the end of 2010.)

- **Paratransit Services in Toledo Area:** A team from Bowling Green State University is investigating the effectiveness of paratransit services and identify key determinants influencing paratransit service quality through surveys of paratransit riders of the Toledo Area Regional Paratransit Service (TARPS). The study revealed that TARPS riders were concerned about untimely performance (lag time), inefficiencies of call-in services, deteriorating service quality and escalating operating costs. ***Practical and affordable solutions were presented by the team:***

  1. Developing a pass card system for frequent riders.

  2. Creating an online reservation system.

  3. Migrating those TARPS riders who do not need a wheel-chair access and physical assistance for boarding to the fixed route, regular public bus transportation system or developing a separate call-a-ride van/taxi-cabs for TARPS riders who do not need daily paratransit services (allowing TARPS managers to use fewer vehicles and smaller, more fuel-efficient vans/taxi cabs instead of buses.

- **MIOH Technology Transfer Program:** In addition to the direct transfer of technologies from MIOH research to the projects' partners (corporations and governmental agencies), poster and paper presentations at many conferences, and the integration of results into educational programs, in the past year the MIOH UTC co-sponsored two significant technology transfer events, focused on intellidrive and alternative fuels.

    1. **Moving Toward Deployment: New Knowledge for ITS Practitioners:** The summer meeting of the Intelligent Transportation Society Michigan (ITS-Michigan) was co-hosted by the MIOH UTC on the campus of the University of Detroit Mercy on July 29, 2009. Members, practitioners, faculty researchers, and students began the day hearing the most recent results of projects funded through the UTC. Later breakout sessions were run ***"to focus, enable and accelerate the creation and implementation of new Intelli-Drive technologies leading to benefits to the people and the economy of Michigan" though either A.) Technologies Push; B.) Market and Community Pull; and C.) Eliminating Barriers to Seamless Collaboration.***

    2. **Alternative Energy Forum Research and Results:** The 2009 Alternative Energy Technology Transfer Forum presented ongoing research and early results from projects at three universities and two corporations. The subjects ranged from biodiesel oxidation and hydraulic hybrids to clean emissions fluids.

    Over 70 professionals from universities, corporations and government agencies attended these two events.

As many MIOH UTC projects are in the final stages of completing the research begun in previous years, even more significant accomplishments are expected in the near future. The following page provides excerpts from DOT strategic documents that are directly related to MIOH UTC focal areas and projects. This is followed by a table that maps the sponsored projects against these top priorities of the DOT.

MIOH UTC hosted faculty and student researchers at the Detroit Economic Club luncheon featuring U.S. Secretary of Transportation Raymond LaHood.

DOT Priorities

Mobility Strategic Objective:
"Advance accessible, efficient, intermodal transportation for the movement of people and goods."

Toward this end, DOT RD&T (e.g. Intelligent Transportation Systems) addresses the following priorities:

1. Exploiting web-enabled and other secure information technologies to share information on best practices in all modes
2. Examining ways to encourage cargo transport by water to improve the capacity of the intermodal transportation system
3. **In consultation with public and private sector partners, conducting research and expediting the deployment of technologies that improve system efficiency** and infrastructure durability
4. **Providing technical assistance and training to improve intermodal transportation planning and effective system management and operation**

Global Connectivity Strategic Objective:
"Facilitate a more efficient domestic and global transportation system that enables economic growth and development."

The increasingly global economy hinges on smooth supply chains and just-in-time manufacturing. Transportation is critical to both. An intermodal approach is central to DOT's role in promoting global connectivity. The following are the Department's RD&T (e.g. National Freight Action Agenda) priorities:

1. Encouraging and facilitating intermodal transportation planning worldwide
2. **Supporting and conducting research on issues concerning the intersection of passenger and freight transportation**
3. **Accelerating the use of ITS and other technologies that reduce delays at key intermodal transfer points, in significant freight corridors, and at international border crossings**

Environmental Stewardship Strategic Objective:
"Promote transportation solutions that enhance communities and protect the natural and built environment."

Transportation exerts pressure on environmental resources worldwide. The *DOT Strategic Plan* calls for a balance between environmental challenges and the need for a safe and efficient transportation network. Among the RD&T (e.g. Crossmodal Initiatives) priorities for achieving this vision are:

1. Supporting the President's Hydrogen Fuel Initiative through research on fuel distribution and delivery infrastructure, transportation of associated hazardous materials, and vehicle safety
2. **Supporting interdisciplinary research on connections among transportation, energy, and the environment**
3. Adopting transportation policies and promoting technologies that reduce or eliminate environmental degradation

4. Collaborating with Federal agencies, academic institutions, and the private sector to support and conduct **research on technologies that improve energy efficiency, foster the use of alternative fuels, and reduce vehicle emissions**
5. **Working with transportation partners to mitigate the adverse environmental effects of existing transportation systems**

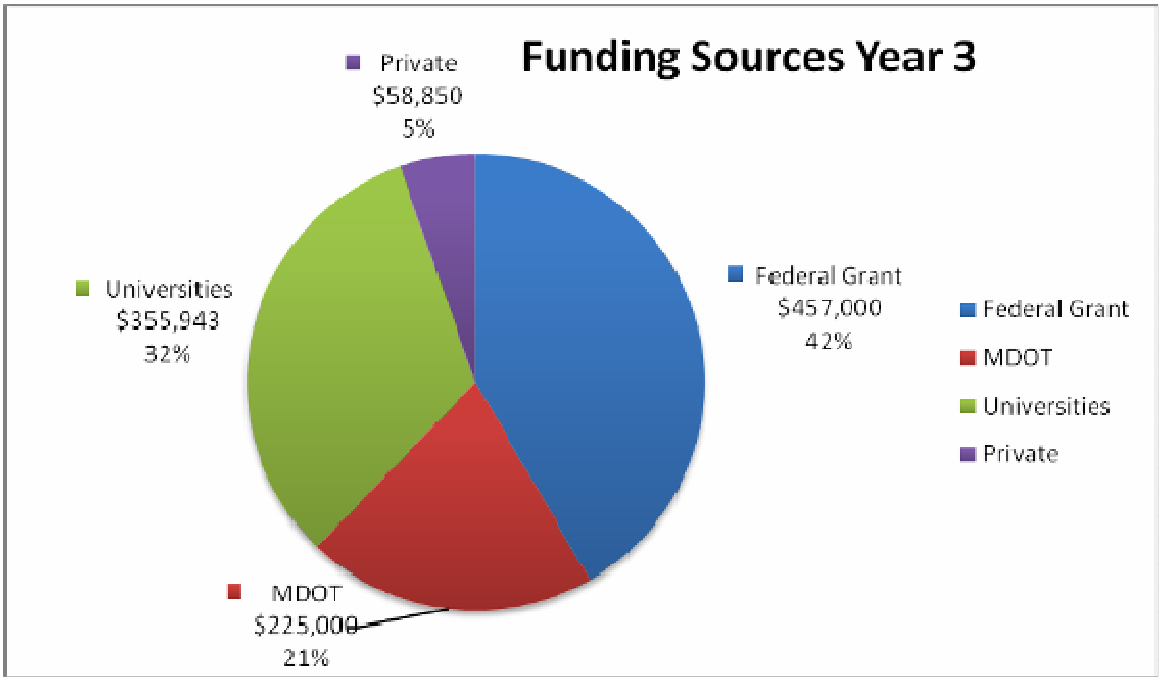
Education and Workforce Development Strategic Objective:

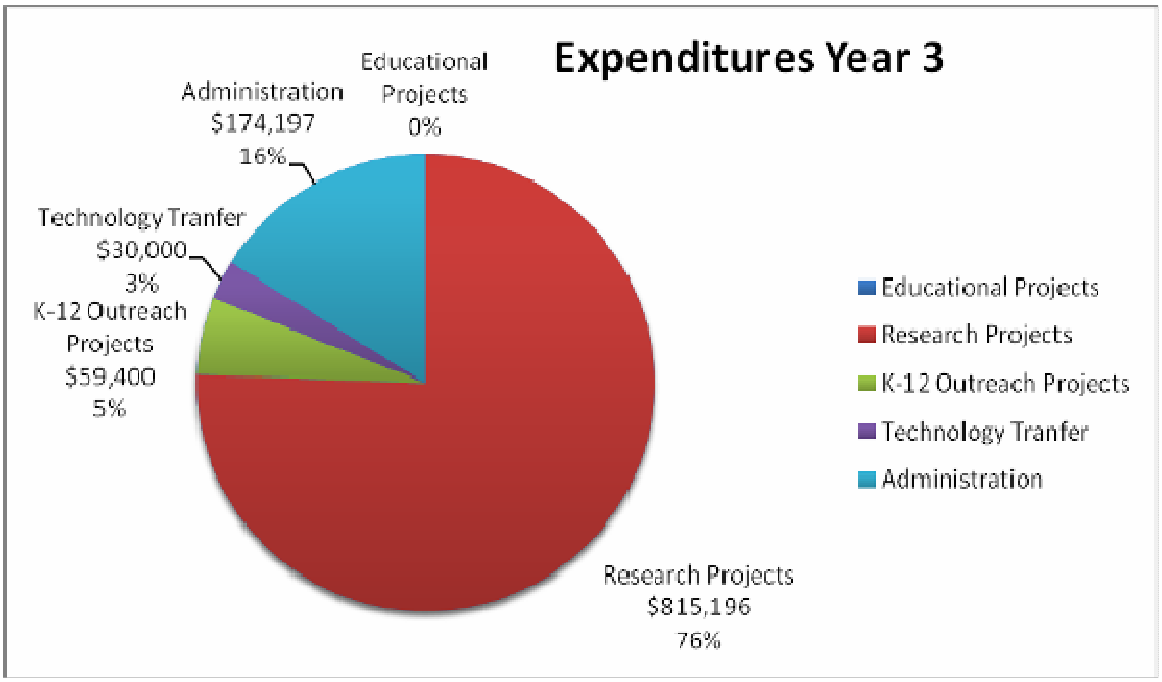
RITA will work with **partners in academia and industry to build the professional capacity of the transportation workforce.** RITA's activities will complement the efforts of DOT's operating administrations by reaching out to the broader transportation and education communities. In addition, the Administration's proposal for reauthorization of surface transportation programs—the Safe, Accountable, Flexible, and Efficient Transportation Equity Act—includes a provision for a new Transportation Scholarship Opportunities Program that RITA will administer.

DOT Strategic Objectives								
	Mobility		Global Connectivity		Environmental			Education & Workforce Development
Funded Projects	**Improve System Efficiency**	**Technical Assistance & Training**	**Intersection of passenger & freight transport'n**	**Accelerating Technologies reducing delays**	**Interdiscipl. research transport'n energy & environm't**	**Improve energy alt. fuels**	**Mitigate adverse environ. Impacts**	
AF1, series 1-3					x	x	x	x
AF3, series 1-2					x	x	x	
AF4, series 1-4					x	x	x	
AF12 series1-2					x	x	x	
AF21 project 1					x		x	
SC1, series 1-2	x	x	x					x
SC2, series 1-4	x		x	x				
TS1, series 1-3	x		x	x				
TS2, project 1	x							
TS4, series 1-2	x		x	x				
TS13, project 1	x							
TS14, project 1	x							
TS15 series1-2	x			x				
TS18 series1-2	x							
TS19, project 1	x							
TS21, project 1	x		x	x				
TS22, project 1	x		x	x				
TS23, project 1	x		x					
K12-1,series1-4					x			x
K12-2,series1-3					x			x
K12-3,series1-3					x			x
K12-14,proj.1-2								x

VII. Illustrations of Funding Sources

Planned Funding Sources and Expenditures Year 3, 2008-2009





VIII. Research Project Status Report

In many cases there are sequential but distinct projects in research or educational areas. As such, the list below identifies sequential projects under the same title, i.e. AF 4, project 1 and AF 4, project 2, etc.

2008-2009 Year 3 New Projects

Research Projects	**Titles**
AF 4, project 4	Improved Oxidative Stability of Biodiesel Fuels: Antioxidant Research and Development
AF 12, project 2	Improving the Energy Density of Hydraulic Hybrid Vehicles (HHVs) and Evaluating Plug-In HHVs
AF 21, project 1	A Proposal on Characterization and Speciation Of Fine Particulate Matter Inside the Public Transport Buses Running On Bio-Diesel
SC 2, project 4	Enabling Congestion Avoidance and Reduction in the Michigan-Ohio Transportation Network to Improve Supply Chain Efficiency: Freight ATIS
TS 15, project 2	New Approach to Enhance and Evaluate the Performance of VII and ITS Communication Systems
TS 18, project 2	A Novel Image Database Analysis System for Maintenance of Transportation Facility
TS 21, project 1	Management and Analysis of Michigan Intelligent Transportation Systems Center Data with Application to the Detroit Area I-75 Corridor
TS 22, project 1	Crash Benefits of SCATS Control System
TS 23, project 1	Transit Oriented Development at Selected LRT Stations in the Detroit Metropolitan Area
K-12 Outreach Proj.	
K 12 -1, project 4	K-12 Outreach Ford PAS Alternate Fuels Module
K 12 -2, project 3	Detroit Area Pre-College Engineering Program (DAPCEP)
K 12 -3, project 3	Transportation Summer Camp – “TransIT Camp”
K 12 -14, project 2	Science Technology & Engineering Review Summer Camp (STEPS)

2008-2009 Year 3 Continuing Projects

Research Projects	**Title**
AF 4, project 1, project 2 & 3	Improved Oxidative Stability of Biodiesel Fuels: Antioxidant Research and Development
AF 12, project 1	Improving the Energy Density of Hydraulic Hybrid Vehicles (HHVs) and Evaluating Plug-In HHVs
SC 2, project 1, project 2 & 3	Enabling Congestion Avoidance and Reduction in the Michigan-Ohio Transportation Network to Improve Supply Chain Efficiency: Freight ATIS
TS 13, project 1	Improving Paratransit Services in the Toledo Metropolitan Area
TS 14, project 1	Modeling Metropolitan Detroit Transit
TS 15, project 1	New Approach to Enhance and Evaluate the Performance of VII and ITS Communication Systems
TS 18, project 1	A Novel Image Database Analysis System for Maintenance of Transportation Facility
Educational Projects	
AF 1, project 1, project 2 & 3	Multipurpose Educational Modules to Teach Hydraulic Hybrid Vehicle Technologies
K-12 Outreach Proj.	
K 12 -1, project 1, project 2 & 3	K-12 Outreach Ford PAS Alternate Fuels Module

Completed Projects

Projects	Titles	Completion Date
AF 3, project 1, project 2	Production of Fuel Ethanol from Cellulosic Peat for Future Transportation Systems	August, 2008
SC 1, project 1, project 2	Supply Chain/Transportation Efficiency Systems Graduate Degree Program	August, 2008
TS 1, project 1, project 2 & 3	Congestion Relief by Travel Time Minimization in Near Real Time	May, 2009
TS 2, project 1	Investigation of Hovercraft Operation in Detroit Weather Conditions	August, 2008
TS 4, project 1, project 2	Evaluation of SCATS Control System	April, 2009
TS 19, project 1	The Woodward Transit Catalyst Project	2009
K 12 -2, project 1	Detroit Area Pre-Collage Engineering Program (DAPCEP)	April, 2007
K 12 -2, project 2	Detroit Area Pre-Collage Engineering Program (DAPCEP)	April, 2008
K 12 -2, project 3	Detroit Area Pre-Collage Engineering Program (DAPCEP)	August, 2009
K 12 -3, project 1	Transportation Summer Camp – "TransIT Camp"	August, 2007
K 12 -3, project 2	Transportation Summer Camp – "TransIT Camp"	August, 2008
K 12 -3, project 3	Transportation Summer Camp – "TransIT Camp"	August, 2009
K 12 -14, project 1	Science Technology & Engineering Review Summer Camp (STEPS)	August, 2008
K 12 -14, project 2	Science Technology & Engineering Review Summer Camp (STEPS)	August, 2009

Project Name: **IMPROVED OXIDATIVE STABILITY OF BIODIESEL FUELS: ANTIOXIDANT RESEARCH AND DEVELOPMENT**

Focal area: **Alternative Fuels** Project Identifier: **AF 4 Research**

AF 4, Project 1: **Nov. 22, 2006 to May 31, 2008**
AF 4, Project 2: **May 1, 2007 to Dec. 31, 2008** continuing
AF 4, Project 3: **Jan. 1, 2008 to Aug. 31, 2008** continuing
AF 4, Project 4: **Sept. 1, 2008 to Aug. 31, 2009** continuing

Principal Investigator: **Dr. Steven O. Salley, WSU**
Co- Investigators: **Dr. K.Y. Simon Ng, WSU**

Student Involvement: **1 graduate student** at Wayne State University.

	AF 4, Project 1 2006-07	**AF 4, Project 2 2007**	**AF 4, Project 3 2007-2008**	**AF 4, Project 4 2008-2009**
US DOT funds	$17,000	$23,000	$21,333	$32,000
Match funds	$13,363	$52,181	$45,871	$50,836
Total funds	$30,363	$75,180	$67,204	$82,836

Project Name: **IMPROVING THE ENERGY DENSITY OF HYDRAULIC HYBRID VEHICLES (HHVS) AND EVALLUATING PLUG-IN HHVS**

Focal area: **Alternative Fuels** Project Identifier: **AF 12 Research**

AF 12, Project 1: **Sept. 1, 2007 to Aug. 31, 2008** continuing
AF 12, Project 2: **Sept. 1, 2008 to Aug. 31, 2009** + no cost extension

Principal Investigator: **Dr. Mohammad Elahinia, UT**
Co-Principal Investigators: **Dr. Mark Schumack, UDM**

Student Involvement: **1 graduate student** at The University of Toledo and **1 graduate student** at University of Detroit Mercy.

	AF 12, Project 1, 2007-08	**AF 12, Project 2, 2008-09**
US DOT funds	$39,270	$49,996
Match funds	$67,333	$51,803
Total funds	$106,603	$101,799

Project Name: **CHARACTERIZATION AND SPECIATION OF FINE PARTICULATE MATTER INSIDE THE PUBLIC TRANSPORT BUSES RUNNING ON BIO-DIESEL**

Focal area: **Alternative Fuels** Project Identifier: **AF 21 Research**

AF 21, Project 1: **Jan. 1, 2009 to Aug. 31, 2009**

Principal Investigator: **Dr. Ashok Kumar, UT**

Student Involvement: **1 graduate student** at The University of Toledo

	AF 21, Project 1, 2008-2009
US DOT funds	$26,666
Match funds	$26,754
Total funds	$53,420

Project Name: **ENABLING CONGESTION AVOIDANCE AND REDUCTION IN THE MICHIGAN-OHIO TRANSPORTATION NETWORK TO IMPROVE SUPPLY CHAIN EFFICIENCY: FREIGHT ATIS**

Focal area: **Supply Chain** Project Identifier: **SC 2 Research**

SC 2, Project 1: **Nov. 22, 2006 to May 31, 2008**
SC 2, Project 2: **May 1, 2007 to Dec. 31, 2008** continuing
SC 2, Project 3: **Jan. 1, 2008 to Aug. 31, 2008** continuing
SC 2, Project 4: **Sept. 1, 2008 to Aug. 31, 2009** continuing

Principal Investigator: **Dr. Ratna Babu Chinnam, WSU**
Co-Principal Investigators: **Dr. Alper E. Murat, WSU**
and **Dr. Gregory Ulferts, UDM**

Student Involvement: **2 graduate students** and **1 undergrad** student at Wayne State University and **1 graduate student** at University of Detroit Mercy.

	SC 2, Project 1, 2006-07	**SC 2, Project 2, 2007**	**SC 2, Project 3, 2007-08**	**SC 2, Project 4, 2008-09**
US DOT funds	$17,870	$27,130	$30,000	$45,001
Match funds	$46,070	$81,378	$103,850	$131,799
Total funds	$63,940	$108,508	$133,850	$176,800

Project Name: **NEW APPROACH TO ENHANCE AND EVALUATE THE PERFORMANCE OF VII AND ITS COMMUNICATION SYSTEMS**

Focal area: **Transportation System Efficiency and Utilization**
Project Identifier: **TS 15 Research**

TS 15, Project 1: **Sept. 1, 2007 to Aug. 31, 2008** continuing
TS 15, Project 2: **Sept. 1, 2008 to Aug. 31, 2009** + no cost extension

Principal Investigator: **Dr. Nizar Al-Holou, UDM**

Student Involvement: **2 graduate students** at the University of Detroit Mercy

	TS 15, Proj. 1, 2007-08	**TS 15, Proj. 2, 2008-09**
US DOT funds	$36,667	$40,000
Match funds	$75,810	$72,144
Total funds	$112,477	$112,144

Project Name: **TRANSPORTATION INFORMATICS: ADVANCED IMAGE PROCESSING TECHNIQUES FOR AUTOMATED PAVEMENT DISTRESS EVALUATION**

Focal area: **Transportation System Efficiency and Utilization**
Project Identifier: **TS18 Research**

TS 18, Project 2: **Sept. 1, 2008 to Aug. 31, 2009** + no cost extension

Principal Investigator: **Dr. Ezzatollah Salari, UT**
Co-Principal Investigator: **Dr. James Lynch, UDM**

Student Involvement: **2 graduate students** at The University of Toledo and **1 graduate** and **2 undergraduate students** at the University of Detroit Mercy.

	TS 18, Proj. 2, 2008-09
US DOT funds	$33,349
Match funds	$39,029
Total funds	$72,378

Project Name: **MANAGEMENT AND ANALYSIS OF MICHIGAN INTELLIGENT TRANSPORTATION SYSTEMS CENTER DATA WITH APPLICATION TO THE DETROIT AREA I-75 CORRIDOR**

Focal area: **Transportation System Efficiency and Utilization**
Project Identifier: **TS 21 Research**

TS 21, Project 1: **Sept. 1, 2008 to Aug. 31, 2009** continuing

Principal Investigator: **Dr. Charles Standridge, GVSU**
Co-Principal Investigator: **Dr. Snehamay Khasnabis, WSU**

Student Involvement: **3 graduate** and **1 undergraduate students** at Grand Valley State University and **1 graduate student** at Wayne State University.

	TS 21, Proj. 1, 2008-09
US DOT funds	$50,000
Match funds	$122,045
Total funds	$172,045

Project Name**: CRASH BENEFITS OF SCATS CONTROL SYSTEM**

Focal area: **Transportation System Efficiency and Utilization**
Project Identifier: **TS 22 Research**

TS 22, Project 1: **Jan. 1, 2009 to Aug. 31, 2009** continuing

Principal Investigator: **Dr. Utpal Dutta, UDM**
Co-Investigator: **Dr. James Lynch, UDM**

Student Involvement: **1 graduate student** and **1 undergraduate student** at the University of Detroit Mercy.

	TS22, Project 1 2008-09
US DOT funds	$16,738
Match funds	$22,258
Total funds	$38,996

Project Name**: TRANSIT ORIENTED DEVELOPMENT AT SELECTED LRT STATIONS IN THE DETROIT METROPOLITAN AREA**

Focal area: **Transportation System Efficiency and Utilization**
Project Identifier: **TS 23 Research**

TS 23, Project 1: **Jan. 1, 2009 to Aug. 31, 2009** continuing

Principal Investigator: **Dr. Snehamay Khasnabis, WSU**
Co-Principal Investigator: **Dr. Utpal Dutta, UDM**

Student Involvement: **1 graduate student** and **1 undergraduate student** at Wayne State University and **1 undergraduate student** at the University of Detroit Mercy.

	TS23, Project 1 2008-09
US DOT funds	$21,138
Match funds	$32,297
Total funds	$53,435

Project Name: **K-12 OUTREACH FORD PAS ALTERNATE FUELS MODULE**

MIOH UTC Project Identifier: **K 12 -1 Educational Outreach**
Focal area: **Alternative Fuels**

K 12-1, Project 1: **Nov. 22, 2006 to May 31, 2008**
K 12-1, Project 2: **May 1, 2007 to continuing**
K 12-1, Project 3**: Sept. 1, 2007 to continuing**
K 12-1, Project 4**: Sept. 1, 2008 to September, 2009**

Principal Investigator: **Daniel Maggio and Dr. Mark Schumack, UDM**

Co- Investigators: **Dr. Stokes Baker, UDM, Dr. James Graves, UDM, Dr. Mark Benvenuto, UDM, Dr. Arthur Haman, UDM**

K 12 -1	**K 12 -1 Project 1 2006-07**	**K 12 -1 Project 2 2007**	**K 12 -1 Project 3 2007-08**	**K 12 -1 Project 4 2008-09**
US DOT funds	$16,957	$0	$2,800	$2,400
Match funds	$9,235	$36,753	$15,000	$9120
Total funds	$26,192	$36,753	$17,800	$11,520

Project Name: **DAPCEP Saturday Class: "Fueling the Car of Tomorrow"**
Detroit **A**rea **P**re-**C**ollege **E**ngineering **P**rogram

MIOH UTC Project Identifier: **K-12 -2**
Focal area: **Educational Outreach, Alternative Fuels**

K 12- 2, Project 1: **Nov. 22, 2006 to August, 2007**
K 12- 2, Project 2: **September, 2007 to August, 2008**
K 12- 2, Project 3: **September, 2008 to August, 2009**

Principal Investigator: **Dan Maggio, UDM**

Student Involvement: **2 undergraduate students** at University of Detroit Mercy.

	K 12 -2 Project 1 2006-07	**K 12 -2 Project 2 2007-08**	**K 12 -2 Project 3 2008-09**
US DOT funds	$6,401	$4,256	$9010
Match funds	$3,600	$778	$3333
Total funds	$10,101	$5,034	$12,343

Project Name: **Transportation Summer Camp "TransIT Camp"**

MIOH UTC Project Identifier: **K12 -3 Educational Outreach**
Focal area: **Transportation Systems**

K 12 -3, Project 1: **Nov. 22, 2006 to Aug. 31, 2007**
K 12- 3, Project 2: **September, 2007 to August, 2008**
K 12- 3, Project 3: **September, 2008 to August, 2009**

Principal Investigator: **Daniel Maggio, UDM**

	K 12 -3 Project 1 2006-07	**K 12 -3 Project 2 2007-08**	**K 12 -3 Project 3 2008-09**
US DOT funds	$17,154	$9,376	$11.670
Match funds	$4,264	$3,104	$2,636
Total funds	$21,418	$12,480	$14,306

Project Name: **STEPS Camp**

MIOH UTC Project Identifier: **K12 -3 Educational Outreach**
Focal area: **Transportation Systems**

K 12 -14, project 1: **September, 2007- August, 2008**
K 12 -14, project 1: **September, 2008- August, 2009**

Principal Investigator: **Daniel Maggio, UDM**

Student Involvement: **1 undergraduate student** University of Detroit Mercy.

	K 12 -14 Project 1 2007-08	**K 12 -14 Project 2 2008-09**
US DOT funds	$6,900	$6,900
Match funds	$8,245	$19,410
Total funds	$15,145	$26,310