MACK-BLACKWELL
Rural Transportation Center

National Transportation Security Center of Excellence

Annual Report
Year One
July 1, 2008 – June 30, 2009
Funding Opportunity DHS-08-ST-061-003
CFDA # 97.061

NATIONAL TRANSPORTATION SECURITY CENTER OF EXCELLENCE
Homeland Security

Department of Homeland Security
Center of Excellence

UNIVERSITY OF ARKANSAS
COLLEGE OF ENGINEERING

University of Arkansas

Executive Director:	**Kevin D. Hall, Ph.D., P.E.**
Director:	**Heather Nachtmann, Ph.D.**
Assistant Director:	**Letitia M. Pohl, Ph.D.**

4190 Bell Engineering Center
Fayetteville, Arkansas 72701
Phone: 479-575-6026
Email: mbtc@uark.edu
Website: www.mackblackwell.org

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OVERVIEW

The Mack-Blackwell Rural Transportation Center (MBTC) has been a nationally recognized transportation research and education center since 1991, when it was authorized by the Intermodal Surface Transportation Efficiency Act. In August 2007, MBTC was designated as one of seven members of the U.S. Department of Homeland Security (DHS) National Transportation Security Center of Excellence (NTSCOE), in accordance with HR1, Implementing the Recommendations of the 9/11 Commission Act of 2007. This document is the Year One Annual Report for MBTC, which covers the period July 1, 2008 to June 30, 2009, with an award amount of $494,000 for that time period. Initial funds were available in January 2009 under Grant Award DHS-08-ST-061-003. Therefore this report represents six months of DHS-funded effort.

As a member of NTSCOE, our focus is the security of the multi-modal transportation systems of the United States at the local, state, regional, and national levels. Our vision is to be a nationally-recognized research and education center dedicated to solving pressing scientific and technological issues related to transportation security, and producing transportation professionals capable of leading public and private sector efforts aimed at providing U.S. citizens a safe and secure transportation system.

MBTC has identified four research areas which support the DHS strategic goals and our "system-of-systems" engineering approach to the resiliency and sustainability of transportation security systems. These capabilities include:

- Supply Chain Security
- Transportation Infrastructure Protection
- Transportation Emergency Preparedness
- Transportation Security Data Integration

During Year One, MBTC has enjoyed significant interaction with DHS personnel for two primary purposes: (1) to provide MBTC with an overview and introduction to the DHS Science and Technology (S&T) Directorate for understanding DHS research activities and future needs; and (2) to provide DHS an understanding of the research, education, and training capabilities of MBTC and the University of Arkansas.

In this initial funding year, ten proposals for research projects related to the initial research framework were received. MBTC leadership, with assistance from DHS, selected the projects that best coupled current strengths with DHS strategic goals and budget constraints. Five projects were selected for initial funding in Year One. Two of these projects are 'base' projects that

support the two core program areas of MBTC's Work Plan. The other three are 'exploratory' grants awarded to investigate areas that reach outside of the MBTC core program areas to make contributions elsewhere. This combination of base and exploratory grants allows MBTC to be responsive to the changing needs of DHS while making early contributions in our core strengths. Research accomplishments during the first six months of funding for these five projects are summarized in the next section. A sixth project (MBTC DHS 1106/DOT 3008), which is currently funded by the Department of Transportation, is also summarized, since it falls under the program area of Transportation Emergency Preparedness and is included in our Year One Work Plan.

Annual performance of the MBTC NTSCOE program activities were measured through success factors in three key areas: research, education, and outreach, as shown in Figure 1. During Year One, ten faculty members participated in NTSCOE research. MBTC research projects relating to homeland security resulted in a number of journal articles, technical reports, presentations, doctoral dissertations, and master's theses. Details on these research accomplishments and progress on each DHS-funded project is summarized in the following section.

MBTC is committed to educating our nation's future leaders and providing them with the expertise to excel in professional and research careers related to transportation security. During Year One, NTSCOE projects provided research opportunities for fourteen graduate students and nine undergraduate students. Additionally, fifteen NTSCOE-related courses were offered at the University of Arkansas, with a total enrollment of 116 graduate students and 115 undergraduate students. Our faculty members also developed one new transportation security related course.

Throughout Year One, our researchers have made efforts to identify how to better meet our nation's security needs by interacting with DHS personnel, federal, state, and local government agencies, and collaborating with researchers at other universities.

Research

- # of faculty involved in center activities 10
- # of faculty from underrepresented groups involved in center activities 1
- # of projects completed 0
- Follow-on funding from other sources 0
- Papers
  - # of journal articles 7
  - # of conference proceedings 0
  - # of technical reports 2
- Presentations
  - DHS sponsored 2
  - Non-DHS sponsored 4
- Software Products Developed 0
- Patents 0

Education

- # of students matriculated 231
- # of graduate students involved in center activities 14
- # of undergraduate students involved in center activities 9
- # of students from underrepresented groups involved in center activities 8

Outreach

- Requests for assistance or advice from DHS 1
- Requests for assistance or advice from Federal, State, Local Government 0
- Congressional Testimonies 0

Figure 1. MBTC Performance Measurements

MBTC NTSCOE RESEARCH PROGRAM

Research Accomplishments

Faculty Involvement

During Year One, ten tenure-track faculty members in both the Civil and Industrial Engineering departments were engaged in NTSCOE research, as indicated in Table 1.

Table 1. Faculty Members Involved in NTSCOE Research, Year One

	Name	Title	Department
1	Justin R. Chimka, Ph.D.	Associate Professor	Industrial Engineering
2	Brady R. Cox, Ph.D.	Assistant Professor	Civil Engineering
3	Kirk Grimmelsman, Ph.D.	Assistant Professor	Civil Engineering
4	Kevin D. Hall, Ph.D., P.E.	Professor	Civil Engineering
5	Ernie Heymsfield, Ph.D., P.E.	Associate Professor	Civil Engineering
6	Scott J. Mason, Ph.D.	Associate Professor	Industrial Engineering
7	Heather Nachtmann, Ph.D.	Associate Professor	Industrial Engineering
8	Edward A. Pohl, Ph.D.	Associate Professor	Industrial Engineering
9	Manuel D. Rossetti, Ph.D., P.E.	Associate Professor	Industrial Engineering
10	Kelvin CP Wang, Ph.D., P.E.	Professor	Civil Engineering

Publications

Since the initial NTSCOE funding was not received until January 2009, the NTSCOE projects were active only during the second six months of Year One. However, MBTC researchers have been doing security-related research for a number of years, and through those efforts during Year One, produced seven journal articles, two Ph.D. dissertations, two master's theses, two technical reports, two DHS-sponsored presentations, and four other presentations. The citations for this work are shown in Table 2.

Table 2. Dissemination of Homeland Security Related Research

Journal Articles
1. Al-Otaibi, Mazen, Kurz, Mary E. and Mason, Scott J., "Analysis of a Tri-Criteria Disaster Relief Scheduling Problem with Precedence Constraints," submitted to *Computers & Industrial Engineering*.
2. Al-Otaibi, Mazen, Mason, Scott J. and Fowler, John W., "Scheduling Models and Heuristics for Disaster-Relief Operations," to be submitted to *OR Spectrum*.
3. Chimka, Justin R., "Gamma Regressive Individuals Control Charts for Influenza Activity," *Quality Engineering*, Vol. 21, No. 2, 182-189, April 2009.
4. Gade, Dinakar and Pohl, Edward A. "Sample Average Approximation Applied to the Capacitated Facilities Location Problem with Unreliable Facilities," submitted to *Journal of Risk and Reliability*.
5. Guzman, Mauricio and Pohl, Edward A. "Application of Reliability Methods to Social Networks," submitted to *Journal of Mathematical Sociology.*

Journal Articles (cont.)

6. Miman, Mehmet and Pohl, Edward A., "Modeling and Analysis of Risk and Reliability for Contingency Logistics Supply Chain," *Journal of Risk and Reliability*, Vol. 222, No. 4, 463-476, 2008.
7. Miman, Mehmet and Pohl, Edward A., "Multi-Objective Optimization of a Contingency Logistic Network through Physical Programming," submitted to *Computers & Industrial Engineering*.

Doctoral Dissertations

1. Al-Otaibi, Mazen, "Scheduling Disaster Relief Operations," Ph.D. Dissertation, University of Arkansas, December 2008. Directed by Scott J. Mason, Ph.D.
2. Miman, Mehmet, "Modeling and Analysis of the Reliability of Contingency Logistic Networks: A Multi-Dimensional Knapsack Approach," Ph.D. Dissertation, University of Arkansas, August 2008. Directed by Edward A. Pohl, Ph.D.

Master's Theses

1. Guzman, Mauricio, "A Probabilistic Programming Approach in the Analysis of Social Networks," M.S. Thesis, University of Arkansas, August 2008. Directed by Edward A. Pohl, Ph.D.
2. Keeley, Adam, "Emergency Medical Response via Inland Waterways" M.S. Thesis, University of Arkansas, May 2009. Directed by Heather Nachtmann, Ph.D.

Technical Reports (funded by U.S. Dept of Transportation)

1. Mason, Scott J., Meller, Russell D. and Pohl, Edward A., "MBTC 2086 – Routing Models for Rural Networks with Time-Varying Constraints," July 2008, available at http://www.mackblackwell.org.
2. Rossetti, Manuel D. and Pohl, Edward A., "MBTC 2088 – Applications of GIS and Operations Research Logistics Planning Methods for Arkansas Rural Transportation Emergency Planning," July 2008, available at http://www.mackblackwell.org.

DHS-sponsored Presentations

1. Hall, Kevin, "Infrastructure of the Future: Structural Health Monitoring," U.S. Department of Homeland Security Third Annual University Network Summit, March 2009.
2. Nachtmann, Heather, "Mack Blackwell Rural Transportation Center – Research Overview," U.S. Department of Homeland Security NTSCOE Director's Meeting, Washington, D.C., May 2009.

Presentations (* denotes presenter)

1. Medal, Hugh*, Mason, Scott J., Meller, Russell D. and Pohl, Edward A., "Routing Models for Rural Transportation Networks with Time-Varying Constraints," Student Poster Session, MBTC Annual Advisory Board Meeting – Student Poster Session, November 2008.
2. Nachtmann, Heather, "Mack-Blackwell Rural Transportation Center," College of Engineering Dean's Advisory Council, Fayetteville, Arkansas, October 2008.
3. Pohl, Edward A.* and Nachtmann, Heather, "Vulnerability Assessment of Rural Transportation Networks," Industrial Engineering Research Conference, Miami, Florida, June 2009.

Presentations (cont.)
4. Sharp, J. Austin*, Nachtmann, Heather and Pohl, Edward A., "Emergency Response Via Inland Waterways," MBTC Annual Advisory Board Meeting – Student Poster Session, November 2008.

Project Progress

Supply Chain Security

The objective of the Supply Chain Security core area is to develop models for resilient, reliable, and sustainable supply chain network design and vulnerability assessment using both reliability- and optimization-based tools and techniques. The concepts of reliability and resilience are relatively new in the supply chain literature. Resiliency is defined as the ability of a system or a set of inter-dependent systems to maintain appropriate performance levels in the face of unplanned events. Sustainability is defined as the ability to efficiently adapt a system or a set of inter-dependent systems to meet changes in performance demands over time in a cost-efficient manner.

Previous research in supply chain management has focused on dealing with demand uncertainties and building "lean" supply chains. While these issues are important, the issue of large scale disruptions affecting supply chains cannot be overlooked. Events this decade such as the 9/11 terrorist attacks, Hurricane Katrina, the 2002 West Coast port closure, and Operations Iraqi Freedom and Enduring Freedom have brought to light the vulnerabilities in current supply chains; in fact, they have motivated the need for new supply chain design tools, models, and techniques.

Supply Chain Security – MBTC DHS 1101

Designing Resilient and Sustainable Supply Chains Networks

Research Team

Name	Role	Department	DHS Funded
Edward A. Pohl, Ph.D.	PI	Industrial Engineering	√
Scott J. Mason, Ph.D.	PI	Industrial Engineering	√
Hugh Medal	Ph.D. Student	Industrial Engineering	√
Behrooz Kamali	Ph.D. Student	Industrial Engineering	√
Huy-Nhiem Nguyen	Ph.D. Student	Industrial Engineering	
Stevenson Sharp	Ph.D. Student	Industrial Engineering	
Willie Montgomery III	M.S. Student	Industrial Engineering	

Project Period: January 2009 – December 2010

Project Funding: $150,000

Research Objectives

This research seeks to develop a fundamental understanding of the inter-dependence within and between critical supply chain infrastructure systems. The impact of this inter-dependence on both the resiliency and sustainability of supply chain systems is quantified, both individually and collectively. This research examines the trade-offs between resource allocation and the efficacy of various types of resources to mitigate supply chain vulnerability. The theoretical foundation upon which analytical methods are constructed and utilized to effectively model, analyze, and improve the resiliency and sustainability of critical supply chain systems. These models would be useful both to emergency response teams and to military and civilian logistics planners during the planning and pre-planning phases of contingency assessment. The objective is to develop solution techniques that are suitable for implementation in decision support tools for contingency planning.

Research Progress

During the first six months of funded research (January 2009 – June 2009), progress includes:

- Conducted an extensive literature review and created an online database of supply chain risk literature
- Developed a risk and vulnerability analysis methodology
- Identified potential multi-modal supply chain networks in the U.S. to conduct risk and vulnerability assessments of the key strategic network elements
- In the process of working with DHS to define appropriate resiliency and sustainability performance measures

Changes from the initially approved project: none

Budget changes: none

Unanticipated problems: none

Transportation Infrastructure Protection

The objectives of the Transportation Infrastructure Projection core area are to develop monitoring systems and advanced materials to enhance the protection and resilience of transportation infrastructure elements. It is important to note that transportation infrastructure elements represent "constructed systems" – therefore, the characterization and assessment of

these systems under normal operating conditions is subject to significant uncertainty. This uncertainty associated with constructed systems is distinct from their "manufactured systems" counterparts which arises from the fabricated/constructed nature of these systems (i.e. variability in welded and bolted connections, composite construction, etc.), the use of different materials and variability in material properties (i.e. steel, ready-mixed concrete, etc.), the typically large physical scale of these systems, local variations in the site conditions and subsurface characteristics of sites, exposure to uncertain or unknown operating conditions (i.e. service loads and their history), environmental conditions, and demands for extremely long service lives. The behavior and performance of any constructed system is ultimately influenced in large part by these factors.

Transportation Infrastructure Protection – MBTC DHS 1104

Structural Health Monitoring and Assessment of Critical Intermodal Transportation Infrastructure Elements

Research Team

Name	Role	Department	DHS Funded
Kirk Grimmelsman, Ph.D.	PI	Civil Engineering	
Brady R. Cox, Ph.D.	PI	Civil Engineering	
Ernie Heymsfield, Ph.D., P.E.	PI	Civil Engineering	
Minghua Qiu	M.S. Student	Civil Engineering	
Alex Font	M.S. Student	Civil Engineering	
Jeremy Rawn	M.S. Student	Civil Engineering	
Christian McGuire	Undergraduate Student	Civil Engineering	
Haley Moore	Undergraduate Student	Civil Engineering	

Project Period: January 2009 – December 2010

Project Funding: $150,000

Research Objectives

The primary objective of the study is to investigate and/or develop a prototype system for remote structural health monitoring of transportation infrastructure elements that can be used for both routine condition assessment and for rapid, post-incident safety evaluation. Structural health monitoring is a concept that may have great merit for assuring the safe operation, rapid assessment, and efficient repair of transportation infrastructure elements, particularly following catastrophic events. It may be possible to develop metrics for these systems based on dynamic measurements that will characterize the global condition and integrity of these elements, and that can be remotely measured and tracked to ensure their serviceability.

Research Progress
During the first six months of funded research (January 2009 – June 2009), progress includes:

- Ongoing comprehensive literature review of available technologies related to remote, real-time structural health assessment and/or post-incident structural condition assessment
- Designed and fabricated physical model for laboratory
- Developed analytical model that characterizes static and dynamic loads
- Initiated experimental testing

Changes from the initially approved project: none

Budget changes: Due to leveraging of research being conducted for a related project funded by the U.S. Department of Transportation, the anticipated DHS expenditures for this project during the first six months (primarily student tuition and travel funds) were not required. The budgeted expenses will be applied in Year Two.

Unanticipated problems: none

Transportation Emergency Preparedness

The objective of this emerging area is to increase the Nation's ability to prepare and respond to emergency situations when responders and citizens are dependent upon transportation. Sound and robust emergency preparedness plans and general emergency education will reduce the vulnerability of transportation systems to terrorist attacks as well as more common crises and assist in the efficiency of a response. Knowledge about and guidance for developing transportation emergency preparedness plans are needed. This emerging program area seeks to improve emergency response operations and planning dependent on transportation as well as provide relevant education products for increasing public awareness and improving communication during and after an event.

Transportation Emergency Preparedness – MBTC DHS 1102

Simulating Transportation Modes in Large-Scale Evacuation Scenarios

Research Team

Name	Role	Department	DHS Funded
Manuel D. Rossetti, Ph.D., P.E.	PI	Industrial Engineering	√
Qingbiao Ni	M.S. Student	Industrial Engineering	√
Huan Guo	Undergraduate Student	Industrial Engineering	√

Project Period: January 2009 – December 2009

Project Funding: $50,000

Research Objectives

The overall goal of this exploratory study is to investigate methods for simulating large-scale evacuation scenarios caused by emergency events such as terrorist attacks and disasters that threaten the safety of the public. The objectives include:

1. Understand the state of the art for modeling large scale evacuations, especially via simulation, and
2. Develop, apply, test, and validate the effectiveness of simulation models on realistic evacuation scenarios, with special emphasis on multiple movement modes (e.g., pedestrians and vehicles).

The purpose of the evacuation scenario is two-fold. First, the evacuation scenario provides a concrete example of the modeling and use of the software. Secondly, the scenario provides a context for experimenting with different evacuation strategies involving multiple modes of transport. For simulating evacuations, the main questions being asked of the simulation model are: "Can the area be evacuated within a prescribed time? Where do the hold-ups in the flow of people occur? And where are the likely areas for a crowd surge to produce unacceptable or dangerous bottlenecks?" The main challenges in simulating crowds and traffic during an evacuation include providing a realistic method of collision avoidance, a strong connection with the environment, and an ability to properly collect numerical and statistical results.

Research Progress

During the first six months of funded research (January 2009 – June 2009), progress includes:

- Purchased, installed and trained students on Paramics simulation software, including generating 3-D representations/movies of the evacuation scenario

- Identified and defined a case study scenario. Based on GIS data from previous research by the University of Arkansas's Center for Advanced Spatial Technologies, this project focuses on the region around Northwest Arkansas Mall and the Wal-Mart commercial area which is the center of shopping in NWA. We assume an emergency has occurred and all staff/customers must evacuate to a safe area.
- Initial data collection and model development has begun. Scenario data collection entails defining the affected communities (e.g. location, population density, etc.), the transportation road network affected, available transport assets and acceptable evacuation criteria.
- Established contact with City of Fayetteville staff concerning traffic volume and road characteristic data, and collaborated with the Center for Advanced Spatial Technologies, University of Arkansas, who provided data related to the geographic area within the case study

Changes from the initially approved project: none

Budget changes: none

Unanticipated problems: none

Transportation Emergency Preparedness – MBTC DHS 1106 (MBTC DOT 3008)

Emergency Response via Inland Waterways

Research Team

Name	Role	Department	DHS Funded
Heather Nachtmann, Ph.D.	PI	Industrial Engineering	
Edward A. Pohl, Ph.D.	PI	Industrial Engineering	
Adam Keeley	M.S. Student	Industrial Engineering	
Leily Farrokhvar	Ph.D. Student	Industrial Engineering	
John Austin Sharp	Undergraduate Student	Industrial Engineering	
Mark Kilgore	Undergraduate Student	Industrial Engineering	

Project Period: July 2008 – December 2009

Research Objectives

This project investigates the feasibility of constructing temporary medical facilities on barges to traverse inland waterways in response to natural or terroristic disasters. Limited resources are available for general hazard relief across much of the Nation. Inland waterways can provide access for equipment and people when other means of transportation are unavailable due to

capacity constraints or destruction. For example, there are over 1,000 miles of navigable waterways in the state of Arkansas that could assist in a catastrophic event such as a New Madrid earthquake in the northeast corner of the state. Particular research questions include:

(1) What medical services should/could be provided?
(2) What is a reasonable response time for such facilities? Is this response time feasible?
(3) What is the optimal barge design?
(4) Is this economically/practically feasible?
(5) How does weather factor in?

Research Progress

This project is funded by the U.S. Department of Transportation through MBTC. Work completed in Year One includes:

- Developed a methodology for assessing the current and potential capabilities of inland waterways in emergency medical response
- Determined which types of communities would benefit from waterway-based medical assistance
- Developed an index-based system to assess feasibility for individual communities using six index factors: accessibility to navigable inland waterways, proximity to barge origin, population demands, social vulnerability, risk of disaster, and limited access to medical services
- Conducted a case study, based on the state of Arkansas, and found that 77% of Arkansas counties have high or moderate potential to benefit from emergency medical response via inland waterways
- Throughout this research project, there was significant collaboration with Randy Hathaway, Deputy District Engineer, U.S. Army Corps of Engineers, Little Rock District; Glenn Proffitt, Chief of Navigation, U.S. Army Corps of Engineers, Little Rock District; and Keith Garrison, Director, Arkansas Waterways Commission.

Transportation Security Data Integration

The objective of the emerging MBTC Transportation Security Data Integration area is to increase the efficiency and effectiveness of the transportation security data supply chain in order to advance threat and risk mitigation.

Transportation Security Data Integration – MBTC DHS 1105

Information Enhancement among Aviation Security Partners

Research Team

Name	Role	Department	DHS Funded
Justin R. Chimka, Ph.D.	PI	Industrial Engineering	√
Qin Hong	Ph.D. Student	Industrial Engineering	√
Ryan Black	Undergraduate Student	Industrial Engineering	√
Maci Dickson	Undergraduate Student	Industrial Engineering	√

Project Period: January 2009 – December 2009

Project Funding: $49,990

Research Objectives

The objective of this project is to adopt and/or develop tools to derive knowledge specific of potential terrorist attacks against general aviation (GA) by integrating a variety of data formats, and transforming raw data into useful and understandable information that enables productive and efficient analysis. The following are important exploratory activities:

1. Consider what is relevant about commercial examples to GA, and make recommendations for improved intelligence and information sharing which originates at GA landing facilities
2. Reference the Airport Characteristics Measurement Tool (TSA Security Guidelines for GA Airports, Information Publication A-001, May 2004) to develop reporting standards, and analyze information that would come from reports
3. Estimate and/or identify models of usual GA activity that could be used to detect potential attacks

Research Progress

During the first six months of funded research (January 2009 – June 2009), progress includes:

- Collected data and literature relevant to GA security
- Estimated models of usual GA activity that could be used to detect potential attacks
- Identified statistical methods that could be used to detect unusual activity that could be attributed to terrorist threat activity
- Developing recommendations for early detection decision aids, and suggestions for better understanding of usual GA activity

- Requested assistance from Charles Sitkoff, DHS, concerning related research being done at Purdue University and Rutgers University, and from Kay Chisholm, Federal Aviation Administration, concerning the *International Journal of Applied Aviation Studies*

Changes from the initially approved project: none

Budget changes: none

Unanticipated problems: none

Transportation Security Data Integration – MBTC DHS 1103

Automated Real-Time Object Detection and Recognition on Transportation Facilities

Research Team

Name	Role	Department	DHS Funded
Kelvin CP Wang, Ph.D., P.E.	PI	Civil Engineering	√
Zhiqiong Hong	Ph.D. Student	Civil Engineering	
Emerson John	M.S. Student	Civil Engineering	√
Ryan Reynolds	Undergraduate Student	Civil Engineering	√
Mark Upchurch	Undergraduate Student	Civil Engineering	√

Project Period: January 2009 – December 2009

Project Funding: $50,003

Research Objectives

Rapid inspection of critical transportation infrastructure elements is essential to the efficient operation of the nation's transportation systems. This is particularly crucial in the period immediately following a catastrophic event, i.e. earthquake, terrorist attack, etc. Rapid response and inspection of transportation infrastructure elements is vital to ensure routes into and out of affected areas are safe for emergency traffic and/or evacuation of persons outside danger zones. The primary objective of this research is to develop a fully automated, real-time, high definition digital video inspection system suitable for implementation on a vehicle-based platform operating at near-highway speeds. Such a system would allow security personnel to rapidly inspect and assess critical infrastructure elements such as bridges, tunnels, rail, and highway surfaces with respect to safety and suitability for use after a catastrophic event.

Research Progress

During the first six months of funded research (January 2009 – June 2009), progress includes:

- Conducted a comprehensive literature review of available technologies related to data collection and visualization of infrastructure imagery in high-definition video sequences
- Purchased equipment and began building a high-definition visualization laboratory facility to serve as the primary platform to support subsequent efforts related to inspection/recognition and assessment algorithms for infrastructure elements

Changes from the initially approved project: none

Budget changes: none

Unanticipated problems: none

EDUCATION

University-based research programs, by necessity, must have strong educational underpinning for long-term success. Faculty and staff researchers rely heavily on undergraduate and graduate students to fully achieve the goals of a research program. These students, in turn, must be provided the solid educational experience necessary to become significant contributors to the research effort. It is vital that the institution have in place, or be committed to develop, those courses which will serve the program. In addition to the research program, MBTC is committed to workforce development. MBTC's vision includes *"…producing transportation security professionals capable of leading public and private sector efforts…"* which necessitates a strong cross- and multi-disciplinary educational program.

Research Assistants

During Year One, there were fourteen graduate students and nine undergraduate students engaged in homeland security related research within MBTC (see Table 3). Of these 23 students, six are women, one is African American and one is Hispanic. As indicated, some of these students were funded by NTSCOE, and some were funded from other sources.

Table 3. Students Involved in NTSCOE Research, Year One

	Name	Position	Department	DHS Funded
Graduate Students				
1	Leily Farrokhvar	Ph.D. Student	Industrial Engineering	
2	Alex Font	M.S. Student	Civil Engineering	
3	Qin Hong	Ph.D. Student	Industrial Engineering	√
4	Zhiqiong Hong	Ph.D. Student	Civil Engineering	
5	Emerson John	M.S. Student	Civil Engineering	√
6	Behrooz Kamali	Ph.D. Student	Industrial Engineering	√
7	Adam Keeley	M.S. Student	Industrial Engineering	
8	Hugh Medal	Ph.D. Student	Industrial Engineering	√
9	Willie Montgomery III	M.S. Student	Industrial Engineering	
10	Huy-Nhiem Nguyen	Ph.D. Student	Industrial Engineering	
11	Qingbiao Ni	M.S. Student	Industrial Engineering	√
12	Minghua Qiu	M.S. Student	Civil Engineering	
13	Jeremy Rawn	M.S. Student	Civil Engineering	
14	Stevenson Sharp	Ph.D. Student	Industrial Engineering	
Undergraduate Students				
1	Ryan Black	Undergraduate Student	Industrial Engineering	√
2	Maci Dickson	Undergraduate Student	Industrial Engineering	√
3	Huan Guo	Undergraduate Student	Industrial Engineering	√
4	Mark Kilgore	Undergraduate Student	Industrial Engineering	
5	Christian McGuire	Undergraduate Student	Civil Engineering	
6	Haley Moore	Undergraduate Student	Civil Engineering	
7	Ryan Reynolds	Undergraduate Student	Civil Engineering	√
8	John Austin Sharp	Undergraduate Student	Industrial Engineering	
9	Mark Upchurch	Undergraduate Student	Civil Engineering	√

NTSCOE-Related Courses

The primary providers of the MBTC educational activities include the Department of Civil Engineering and the Department of Industrial Engineering. The coursework from these two departments, joined with others, support two of the College of Engineering key programmatic activities (Transportation, Logistics and Infrastructure; and Homeland Security) to offer students both technical and domain training in transportation security.

The Four Year Work Plan, dated April 30, 2009, identifies 26 NTSCOE-related courses provided at the University of Arkansas. During Year One, 15 of these 26 courses were offered, with a total enrollment of 116 graduate students and 115 undergraduate students, as shown in Table 4.

Table 4. NTSCOE-Related Courses Taught During FY 2009 at University of Arkansas

Course Number	Course Title	Undergraduate Students	Graduate Students
Technical			
CVEG 5463	Transportation Modeling		7
INEG 4383/ 5383	Risk Analysis in Transportation and Logistics	4	19
ELEG 5653	Artificial Neural Networks		9
INEG 4623	Introduction to Simulation	41	
INEG 5333	Design of Industrial Experiments		8
INEG 5613	Optimization Theory I		11
INEG 5643	Optimization Theory II		7
INEG 6823	Systems Simulation II		5
Domain			
CVEG 4433	Transportation Pavements and Materials	49	2
CVEG 5413	Transportation and Land Development		5
CVEG 5483	Transportation Management Systems		4
TLOG 5653	Global Logistics Strategy		21
TLOG 5673	Transportation and Logistics Modeling		11
INEG 4433	Systems Engineering & Management	21	2
MEEG 5263	Introduction to Micro Electro Mechanical Systems		5
	Totals	**115**	**116**

Curriculum Development

During Year One, one new security-related course was developed: INEG 4383/ 5383 Risk Analysis in Transportation and Logistics. The course development was provided by Dr. Edward Pohl, and funded by MBTC under project MBTC DOT 2061. The new course, offered in the Spring 2009 semester, presents engineering students with the fundamentals of modeling risk,

analyzing risk, and managing risk in a variety of industrial and government decision making settings, with a focus on the transportation and logistics problem domain.

OUTREACH

MBTC's outreach program involves sharing our research results through conference and seminar presentations; collaborating with industry and with local, state and federal government agencies to ensure the applicability of our research to the nation's transportation needs; and interacting with the community through K-12 programs that introduce children to careers in transportation. These outreach efforts have been successful in the past because MBTC leadership and faculty researchers are actively involved in academic and professional associations, and through previous projects have formed partnerships with transportation industry and government leaders.

Throughout Year One, MBTC researchers have made efforts to identify how to better meet our nation's security needs by interacting with DHS personnel, federal, state and local government agencies, and collaborating with researchers at other universities. Each project progress report indicates these interactions, but they are also summarized in Table 5. For example, Dr. Heather Nachtmann was contacted by Ms. Jeanne Lin at DHS to develop a proposal for renewable energy in inland waterways, which was subsequently funded in July 2009 by the Borders and Maritime Security Division.

Table 5. External Collaboration and Interaction with Government Agencies

Name	Title	Organization
Jeanne Lin	Deputy Director, Science & Technology Directorate	Department of Homeland Security
Charles Sitkoff	Science & Technology Directorate	Department of Homeland Security
Randy Hathaway, Ph.D., P.E.	Deputy District Engineer	U.S. Army Corps of Engineers, Little Rock District
Glenn Proffitt	Chief of Navigation	U.S. Army Corps of Engineers, Little Rock District
Keith Garrison	Executive Director	Arkansas Waterways Commission
Kay Chisholm	Managing Editor, *International Journal of Applied Aviation Studies*.	Federal Aviation Administration
Jeff Coles	Transportation Division	City of Fayetteville, AR
Christina Scarlat	Research Assistant	Center for Advanced Spatial Technologies, University of Arkansas
Dr. Pat Driscoll	Professor of Systems Engineering	United States Military Academy

ORGANIZATION, MANAGEMENT and PARTNERS

MBTC has been a nationally recognized transportation research and education center since 1991 when it was authorized by the Intermodal Surface Transportation Efficiency Act. The center is one of seven charter members of the DHS NTSCOE. Its fundamental assets include established procedures for research solicitation, evaluation and dissemination, strong educational program development and state of the art professional training programs through our *Center for Training Transportation Professionals* (CTTP). MBTC has established relationships with all critical transportation security stakeholders including federal, state and local government agencies, universities and colleges, minority-serving institutions, industry partners, and professional associations.

The administrative team of MBTC spearheads the effort to plan, establish, and execute the transportation security mission of the center. Figure 2 shows key MBTC administrative personnel. Dr. Kevin D. Hall, Principal Investigator and Executive Director, oversees the effort. Dr. Heather Nachtmann, MBTC Director, leads all planning processes and provides the bulk of the day-to-day administration of the program. Dr. Letitia Pohl, Assistant Director of MBTC, provides managerial support. Dr. Stacy Williams is the director of CTTP. Administrative and financial planning support is provided by MBTC staff.

In addition to the MBTC staff, the Center also benefits from oversight and input from its Executive Committee (Department Heads of Civil Engineering and Industrial Engineering, Chaired Professor in Transportation Marketing and Logistics, Vice-Chancellor for Research/Dean of the Graduate School), Professional Advisory Board and Academic Advisory Board. The 15-member Professional Advisory Board meets annually to receive updates on Center activities and provide strategic direction for Center programs. All education and training efforts sponsored by the Center are reviewed and guided by the five-member Academic Advisory Board.

MBTC also enjoys strong relationships with other research centers located at the University of Arkansas. To date, MBTC has collaborated with on-campus centers which include the Center for Innovation in Healthcare Logistics (CIHL), the Center for Advanced Spatial Technology (CAST), the Center for Engineering Distribution and Logistics (CELDi), and the Radio Frequency Identification (RFID) Center.

MBTC emphasizes collaboration with minority-serving institutions, building on a successful research partnership with the University of Arkansas at Pine Bluff (a historically black university). The NTSCOE offers prime opportunities for collaboration with member institutions including Tougaloo College and Texas Southern University.

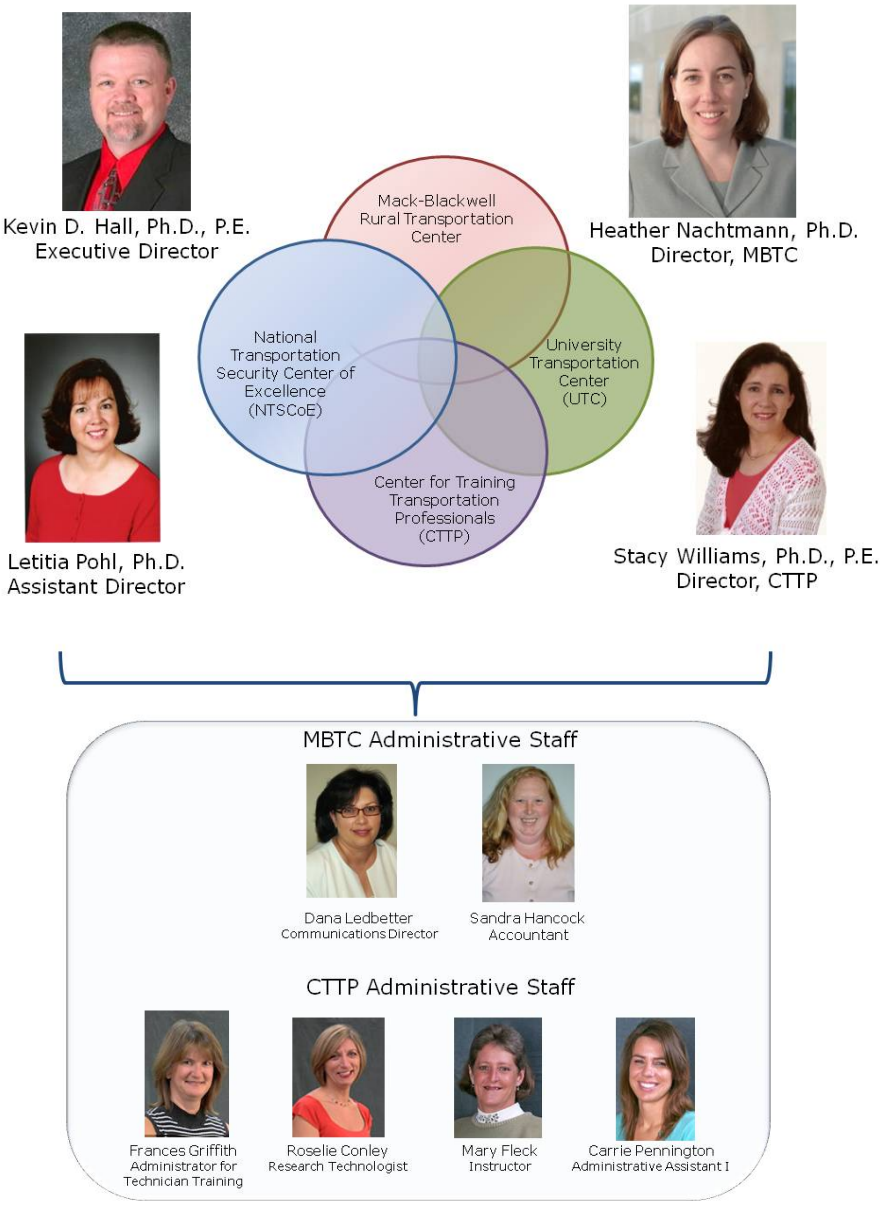

Figure 2. MBTC Administrative Personnel

PATENTS

To the best of my knowledge, I, Heather Nachtmann, MBTC Director, certify that no patentable inventions were created during Year One.

Heather Nachtmann

FINANCIAL REPORT

Available upon request.