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Engaging Academia: Creating Partnerships for Organizational Innovation

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DHS Office of University Programs
USCG-Relevant Programs

Office of University Programs
Science and Technology Directorate

November 2010
DHS Office of University Programs

- Programmatic Thrusts
  - Centers of Excellence
  - Education Programs
  - Minority Serving Institutions
Centers of Excellence Congressional Mandate

Homeland Security Act of 2002:
“The Secretary, acting through the Under Secretary for Science and Technology, shall designate a university-based center or several university-based centers for homeland security. The purpose of the center or these centers shall be to establish a coordinated, university-based system to enhance the Nation's homeland security.”

(as amended)
Developing …

“A Coordinated University-Based System”

- Multi-COE, multi-division, -component, -disciplinary projects
  - Target cross-cutting areas of uncertainty and critical need
  - Integrating National Labs/others in joint COE projects
- Multi-national, multi-disciplinary workshops in U.S., EU, Asia
- Instituting transition plans for all COE project areas
- Integrating MSIs into COEs
- Transitioning COE students, scholars and fellows to DHS and Federal labs, industry, universities, foreign institutions
- Integrating Education with COEs and DHS Components
Office of University Programs’ Mission

Maximize DHS’ return on investment in university-based research and education
Guiding Principles to Maximize ROI
Business Model

- Effective → Do the right work [quality products]
- Efficient → Do the work right [lowest cost]
- Enduring → Recoup the investment [returning customers]
- Equal Opportunity → Reflect America to Protect America
  [build customer base for the future]
12 DHS Centers of Excellence

1. Center for Risk & Economic Analysis of Terrorism Events (CREATE)
   ▪ Lead: University of Southern California

2. National Center for Foreign Animal & Zoonotic Disease Defense (FAZD)
   ▪ Lead: Texas A&M University

3. National Center for Food Protection & Defense (NCFPD)
   ▪ Lead: University of Minnesota

4. National Consortium for the Study of Terrorism & Responses to Terrorism (START)
   ▪ Lead: University of Maryland

5. Center for Advancing Microbial Risk Assessment (CAMRA)
   ▪ Lead: Michigan State University, in Partnership with U.S. EPA

6. National Center for Preparedness & Catastrophic Event Response (PACER)
   ▪ Lead: Johns Hopkins University

7. Center for Awareness and Location of Explosives-Related Threats (ALERT)
   ▪ Research Co-Lead: Northeastern University
   ▪ Education Co-Lead: University of Rhode Island
12 DHS Centers of Excellence

8. National Center for Border Security and Immigration (NCBSI)
   - Research Co-Lead: University of Arizona
   - Education Co-Lead: University of Texas at El Paso

9. Center for Maritime, Island and Port Security (MIPS) - meets Safe Ports Act
   - Maritime and Islands Co-Lead: University of Hawaii (CIMES)
   - Port Security Co-Lead: Stevens Institute of Technology (CSR)

10. Natural Disasters, Coastal Infrastructure and Emergency Management (NDCIEM)
    - Research Co-Lead: University of North Carolina at Chapel Hill (DIEM)
    - Education Co-Lead: Jackson State University (NDCIEM)

11. National Transportation Security COE (NTSCOE) – Required by HR-1
    - Research Co-Lead: University of Connecticut
    - Education & Training Co-Lead: Tougaloo College
    - Petro-Chemical Transportation Co-Lead: Texas Southern University

12. Command Control and Interoperability (C2I)
    - Co-Lead: Purdue University
    - Co-Lead: Rutgers University
Potential USCG –OUP Engagement
Working with OUP

- Write COE FOAs with a team
- Review COE proposals (Stage 2)
- Site visits (Stage 3)
- Internships for DHS Scholars and MSI Students
- Participate on COE Federal Coordinating Committees
- Participate in COE mid-term review panels
Centers of Excellence - Mission Relevance to the USCG

- Strengthen maritime domain awareness and safeguard populations and properties unique to U.S. Island, remote/extreme environments. (MIREES)
- Evaluation of risks, costs and consequences of terrorism and to guide economically viable investments in homeland security. (CREATE)
- Human causes and consequences of terrorism that is directly relevant to homeland security policymakers and practitioners (START)
- Medical and public health preparedness strategies, response capabilities, and surge capacity. (PACER)
- Safeguard populations, properties and economies and improve community resiliency to the consequences of natural disasters, including hurricanes, floods, earthquakes, and wildfires (NCDIEM)
- Analyze, understand and apply diverse, diffuse, and distributed data on threats and manmade or natural disasters in the presence of uncertainty (CCI)
- Explosive materials formulation and characterization; investigation of mitigation materials and techniques; improved detection of high-energy materials and associated technologies; increased understanding of unconventional explosive threats; and continued algorithm development and sensor fusion strategies for improved threat detection. (ALERT)
Centers of Excellence – Current USCG Related Projects

- Center of Excellence for Maritime, Island and Remote and Extreme Environment Security (MIREES)
  - Space Surveillance
  - HF Radar and Over-The-Horizon Surveillance
  - Nearshore and Harbor Surveillance
  - Design for Resiliency
  - Satellite Detection and Tracking of Ships
  - Coastal Radar Detection
  - Harbor Acoustics Monitoring
  - Decision Support Systems

- Center for Risk and Economic Analysis of Terrorism Events (CREATE)
  - PortSec - Port Security Risk Management and Resource Allocation

- National Transportation Security Center of Excellence (NTSCOE)
  - Sustaining Resilient Inland Waterways via Renewable Energy Project
  - Emergency Response via Inland Waterways Project
Centers of Excellence – Current USCG Related Projects

- National Center for Zoonotic & Animal Disease Defense (ZADD)
  - Dynamic Preparedness Simulator (DPS)
- The National Center for Food Protection and Defense (NCFPD)
  - Consequence Management System
  - Freight Transportation Risk and Resiliency in International Food Supply Chains
- Center for Natural Disasters, Coastal Infrastructure & Emergency Management
  - Meteorological Modeling
  - Hydrologic Modeling System for Coastal Environments
  - Coastal Wave Surge Modeling
  - Application of ADCIRC Coastal Circulation Model for Predicting Near Shore and Inner Shore Transport of Oil from the Horizon Oil Spill
  - Hurricane Forecasting Methodologies

Homeland Security
The Problem – Two Competing Needs:

- **Protection** of the ports: Ports are a critical part of our Nation’s infrastructure
  - Provide jobs (locally and nationally)
  - Support import/export business
  - Critical component of the Nation’s supply-chain.
  - **They are major, high-value terrorist targets**

- **Economic viability**: goods *must* flow
  - Need to minimize interruptions to business, avoid increasing costs of doing business
  - **Excessively costly/disruptive protection causes economic harm to US, satisfies terrorist aims**

Challenges:

- **System of systems**: Ports and similar operations are composed of many different components
  - Makes risk assessment and management difficult
  - Difficult to model and analyze

- **Dynamic operations**: Constantly changing, both day-to-day and long-term
Center for Risk and Economic Analysis of Terrorism Events (CREATE)

PortSec - Port Security Risk Management and Resource Allocation

PortSec Solution: Two Modes

- **Tactical system** addresses daily security needs
  - Risk calculations based on collected intelligence
  - Continuously monitors for changes and recalculates assessed risk of attack to the port complex
  - Calculates attack risks, assesses port operations costs resulting from resource re-allocation to address risk
- **Initial prototype under evaluation at POLA/POLB**

- **Strategic system** addresses resource allocation and investment questions
  - Considers long-term picture of port operations (e.g., expansions)
  - Supports “what-if” cost-benefit analysis
National Transportation Security Center of Excellence (NTSCOE)
University of Arkansas – Mack Blackwell Rural Transportation Center

- **Sustaining Resilient Inland Waterways via Renewable Energy Project**
  - Explore how renewable energy sources can be utilized to support inland waterway security and operations.

- **Emergency Response via Inland Waterways Project**
  - What are the emergency response capabilities of inland waterways?
  - What is the feasibility of providing emergency medical services via barge?
  - Which types of communities could benefit from such a service?
Active USCG-COE Engagement
Improving Port System Resiliency for the National Interest - May 2009

Objective:
- Identify the critical challenges to building resiliency of our Nation's port system as a whole
- Understand knowledge gaps to develop appropriate tools, models and methodologies for decision-makers to use in the future.

Organization:
- Participants: State, local and international stakeholders, port managers, academics and researchers, and other federal agency officials
- Focused initial efforts on a common understanding of resiliency
- Identified challenges to the port system from a national perspective based on a nationally significant scenario
- Identified failure modes, interdependencies with other systems, impacts on the global supply chain, and cascading effects of related system failure.
- Explored the relationship between individual (local/regional) port resilience and overall U.S. (national) “port system” resilience.

Outcome:
- Further develop the research needed to address future challenges by socializing the results with stakeholders with the goal of supporting future studies as appropriate.
  - Still TBD
Objective:
- To explore and identify ways in which scientific research and development could improve the ability of the U.S. Coast Guard (USCG) to operate and carry out its statutory missions in the Arctic region.

Organization:
- Participation included state, local and international stakeholders, academics and researchers, and USCG and other federal agency officials
- USCG described existing challenges and capability gaps in the Arctic,
- Researchers reported on research projects underway to address these challenges
- Working groups - infrastructure, sensors, and communications - identified key areas where R&D could improve Coast Guard capabilities in Arctic
- Attendees brainstormed on research questions - virtual navigation aids, voice communications, consolidated climate and environmental data, and parameters for an Arctic response boat.

Outcome:
- The USCG and S&T have reviewed and prioritized research areas. Will follow up with requests for proposals from COEs.
Transitioning Auxiliary Stations to Stations (Small)

Problem:
- Search and Rescue (SAR) Stations Operated by CG Auxiliary are no longer sustainable based on current staffing levels.

Objective:
- Determine if requirements dictate a presence, and change the designation of needed stations to Active Duty Station (Small).

Outcome:
- USCG (LANT-7) partnered with the DHS Center of Excellence VACCINE (Visual Analytics for Command, Control, and Interoperability Environments) at Purdue University.
- VACCINE provided SAR Case Data Visualization to better understand the impact of D9’s unique AUXOP Stations.
- USCG made recommendations based on the next steps for evaluating transition from Auxiliary to Active Duty Stations.
Great Lakes Economic Risk Study

Problem:
- The economic value of CG Prevention activities is unknown.
  - 15 major international ports and some 50 smaller, regional ports on the Great Lakes-St. Lawrence Seaway system
  - More than 60% of seaway traffic travels to and from overseas ports, (iron ore, coal, grain and steel make up about 80 percent of cargoes shipped each year)
  - Vital MTS that provides a link between the world marketplace and the industrial and agricultural heartland of North America.

Objective
- Quantify the value of CG Prevention activities and publish statistically defensible economic measures.

Outcome
- VACCINE engaged to provide visual analytics of data on boating and other incidents in the Great Lakes and development of a resourcing model projecting needs for Coast Guard ships and personnel.
Boston Sector Deterrence Model

Problem:
- Currently no method of measuring the deterrent value of forces applied to executing PWCS patrols and scheduling.

Objective:
- Provide Sector schedulers with a tool to randomize patrols against weighted targets in order to maximize effectiveness while minimizing impact on operational forces.

Outcome:
- DHS Centers of Excellence at the University of Southern California (USC) – (CREATE) utilizing game theory to build complex algorithms,
- Purdue University (VACCINE) developing data visualization interfaces
- To maximize PWCS patrol deterrence effects through randomization for use by any Operational Commander.
Academic Maritime Risk Symposium

USCG/CREATE Maritime Risk Symposium, 16-18 Nov
University of Southern California, Los Angeles, CA

**Purpose:**
- Evaluate risk and economic consequence assessment methodologies and tools, assessment results, and policy implications and impacts, focused on the
  - Maritime Domain.

**Challenge:**
- How can academia and government approach this issue together?
Other USCG COE Engagement

- CCICADA (Rutgers) COE on advanced data analysis:
  - Tayfur Altiok is doing research/analysis for USCG on risk assessment for the Delaware River
Future Engagement

- Basic Ordering Agreements (contracts)
  https://collaborate.st.dhs.gov/oup/boa/default.aspx
- Modifications of Cooperative Agreements for Research (assistance agreements)
- Website and database of projects at:
  - www.hsuniversityprograms.org
- Educational Opportunities for DHS Staff
- Hosting COE Professors on Sabbaticals
The Naval Postgraduate School is a . . .

- **Graduate University**
  Responsive to joint, interagency, and coalition requirements

- **Research Institution**
  Pursuing innovative technology and improving national security

- **Community of Alumni**
  Leading and defending the Nation and transforming the Department of Defense (DoD)

### History Highlights

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>1909</td>
<td>Founded at the U.S. Naval Academy</td>
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<tr>
<td>1951</td>
<td>Moved to Monterey</td>
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<tr>
<td>1951</td>
<td>Operations Research Department</td>
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<tr>
<td>1956</td>
<td>Systems Management Department</td>
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<tr>
<td>1972</td>
<td>National Security Affairs Department and War-Fighting curricula (e.g., Anti-Submarine Warfare)</td>
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<tr>
<td>1996</td>
<td>Information Warfare Curriculum</td>
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<tr>
<td>1999</td>
<td>Joint Professional Military Education (JPME) campus</td>
</tr>
<tr>
<td>2003</td>
<td>Homeland Security Curriculum</td>
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<tr>
<td>2004</td>
<td>Information Operations</td>
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Core Characteristics

• Integrated • Systems-Oriented • Flexible • Partnered for Strength

4 Institutes

The Cebrowski Institute for Information Innovation and Superiority

The MOVES Institute Modeling, Virtual Environments, and Simulation

The Meyer Institute National Security Systems and Technology

National Security Institute Partnership developed for National Security research and education

Institutes ensure that education provided by the Schools is applied to military challenges

4 Schools

Graduate School of Engineering and Applied Science
Graduate School of Operational and Information Sciences
Graduate School of Business and Public Policy
School of International Graduate Studies
Resident Degree Program Enrollment (Winter 2nd Quarter 2010)

Total Resident: 1,488

U.S. 85% - All Military Services and Other Government Agencies
International 15% - 223 Residents from 44 countries
Collaboration in Action

• The Center for Homeland Defense & Security
• The National Security Institute
• Maritime Defense & Security Research Program
  – Information Sharing - Infrastructure Protection
  – SPSS/ Seaweb - Unmanned Systems
  – Piracy - War gaming
• Various Research and Field Experimentation
  – Example- Maritime Interdiction & Interoperability
• Collaborative Curriculum Development
  – Example- Maritime Security Certificate Course
USCG Thesis Topics: (118 total)

Covering: MDA, Situational Awareness, Manpower, Acquisition, Terrorism, Interoperability, Measures, Stall analysis, Vibration, Service Orientated Architecture, Modeling, Resiliency, Recruitment, Intelligence, Innovation, Katrina Response, Public Affairs…
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Shared Learning Outcomes

- Leadership Ability
- Personal and Professional Qualities
- Critical Thinking Ability
- Ability to Acquire, Integrate and Expand Knowledge
- Ability to Communicate Effectively
USCGA Core Curriculum – Components

Well Being/Physical
Professional
Leadership
Liberal Arts
Technical
Academic Majors

• Government *(international affairs track/public policy track)*
• Management
• Marine and Environmental Sciences *(chemistry/biology/physics-2 of 3)*
• Operations Research and Computer Analysis
• Civil Engineering
• Electrical Engineering *(systems emphasis/computer emphasis)*
• Mechanical Engineering
• Naval Architecture and Marine Engineering
Our Changing World-Curricular Evolution

Activities/Project-based study
Elective Courses
Outside Sponsorship
Enhanced Course Management Tools
Pedagogical Variations/Methodologies

11/12/2010
Co/Extra-Curricular Experiences

- Scholar’s Projects
- Advanced Research Projects
- Directed/Independent Research
- Capstone Courses/Projects
- Honor’s Program
- Internships
Undergraduate Research

Benefits
Attracts students to majors/careers (particularly in STEM)
Strong mentoring relationships
Cross disciplinary dialogues
Develop motivation and confidence to persist
Desire to advance studies-lifelong learning
Ability to handle open ended problems-uncertainty

Costs
Strain on faculty-partnership management
200 week cadet program
Tremendous pressure on limited technician and admin support
Limited mechanisms for accepting non-appropriated resources (people/funds)
Partnerships/Connectivity

CG Field Units
CG Directorates
Government Labs
Other Colleges/Universities
Leadership Development Center
Institute for Leadership
Center for Maritime Policy and Security Studies
United States Coast Guard Academy

Unique Capacity/Capability

Tow Tank/Circulating Water Channel
SIPRNET Classroom (Secret Internet Protocol Router Network)
Ship Bridge/Radar Simulator
Cyber-Defense/Network Security Laboratory Laboratory
Training Vessels/Boats

11/12/2010
Applied Research Laboratories
The University of Texas at Austin:
A Navy University Affiliated Research Center
ARL:UT in Brief

• One of five Navy University Affiliated Research Centers (UARCs)
  - Operate under Director, Defense Research and Engineering (DDR&E) charter and management plan with sole-source contract
  - Maintain university-based engineering and technology capabilities deemed essential to DoD

• Technical Program Areas: Acoustics, Electromagnetics, Information Technology
  - Emphasis on basic and applied research leading to prototype development for defense and national security applications

• Organization
  - ~650 staff
    • 325 research staff (20% PhD, 50% MS/MA, 30% BS/BA)
    • 75-150 students (all U.S. citizens)
  - ~$75M/yr funding (all soft money)
  - Secure facility (all professional staff have security clearances)
UARCs, Academia, and Innovation

- UARCs are a bridge between operational needs and academic research
  - Focus on applied problems to solve operational needs, but with reach back to basic research on campus

- UARCs facilitate faculty involvement in applied problems
  - Awareness of operational needs
  - Assist with competing faculty requirements (publish, graduate students)
  - Access to classified facilities

- UARCs engage students in research relevant to national security.
  - Workforce renewal.

- UARCs can bridge Navy development with DHS needs
Swimmer Detection Sonar

- ARL-developed AN/WQX-2 is currently in use by USN and Coast Guard in integrated waterfront security systems.
  - Automated detection, tracking, classification and alerting for surface and subsurface intruders.
  - Installed at various Navy bases worldwide.
- Selected for use by US Allies for protection of key naval bases.
Diver Hull Imaging and Navigation Sonar

- Provides capability to inspect the hull of a ship to find attached mines or other devices.

- Current Implementation:
  - Diver held auto scanning sonar
  - Image data remoted to surface and displayed in diver face mask
  - Incorporates beacon-based acoustic navigation system with orientation & depth sensors
  - Full voice communications with diver

- Potential for AUV implementation
Seaweb

Rapidly deployable, persistent underwater acoustic surveillance network for illicit trafficking

- Collaborative development with Naval Postgraduate School
- Mature system: TRL 6-8
- Networked acoustic communications for near-real-time contact reporting
- Deployable, autonomous, distributed sensors with in-sensor detection and classification
Academic Collaboration with the US Coast Guard

Professor Ananth. V. Iyer
Susan Bulkeley Butler Chair in Operations Management
Director DCMME and GSCMI
Krannert School of Management
Purdue University
West Lafayette, IN 47907
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(all projects co-authored with Professor Deshpande)
Projects between 2001 and 2009

Resources

• Five Sponsored Projects between ARSC (Elizabeth City) and Purdue University
• All projects focused on the Air Assets Supply Chain (ARSC) at Elizabeth City and airstations
• Masters Students from the Krannert School of Management and School of Industrial Engineering at Purdue University
• PhD student from the Krannert School
• Student interns worked at ARSC in the summer and went to airstations when necessary
• Faculty – Professors Deshpande and Iyer
• USCG officers at Krannert for MSIA degree – independent study projects to test completed projects and push results
Focus on one project

- **HH-65 B to C conversion and CG2 to CG4 conversion**
- Initial problem – Timeline for conversion, shortage of Gearbox conversion kit
- Possible Choices – full flexibility, partial flexibility
- Rate of conversion of aircraft, overhaul interval for converted aircraft
- Model showed the impact of kit constraint, overhaul interval, repair time on aircraft availability
- Mathematical programming model generates performance estimates, shadow prices, impact of changes in parameters
- Decisions regarding number of new kits to purchase and impact on performance
- Justification for congressional request for additional funding for gearbox kits
Academic Impact

• Modeling product transitions in a supply chain
• General model and results
• Doctoral thesis (Asima Mishra) who now works for Intel Research
• Two academic papers under review or revision
• The general problem of product transitions is now being applied to EPA regulation and product impact (another thesis)
• This is a new emerging area in Supply Chain research
• It is now taught in Supply Chain courses at Krannert and will be in a textbook I am writing (for McGraw Hill)
Our Approach

• Original problem definition by USCG officers
• Collaborative definition (USCG and Purdue) of technical solution approach, software used, tasks and timeline
• Collaborative Definition of the scope of the prototype solution – to be comprehensive, enable estimation of benefit, cover a range of assets
• All projects data intensive – focus on use of raw data at the transaction level
• On site Purdue student interns - to learn about data specifics from personnel who enter data, interpret data etc (Crucial)
• Models used (Optimization, Simulation, Statistical) and software used coordinated with licenses at Elizabeth City
• All solutions, code etc handed over to USCG – none of the solutions were property of Purdue
• Scale up of the prototype solutions contracted with private companies
Timeline of Project vs Academic Output

Issues to Manage

• Project Entire Timeline usually within one year
• Academic Calendar vs Project Calendar
• Data Analysis and feedback from USCG – crucial
• On site visits and discussion with users
• Masters students role (project focused) vs doctoral students role (long term research contributions)
• Submit results for independent review (peer review), prizes (Edelman Award)
• Two papers published, two in the pipeline, one doctoral thesis
• Presentations at over 20 universities worldwide and conferences - to collect feedback
Issues to consider

• How do we keep USCG relationships beyond specific project completion?
• Can the work with USCG be used for other USCG assets (ships) - for DHS, or at other Defense entities (Navy, Airforce)?
• Are there mechanisms other than project based approaches that could work?
• Any other suggestions.

THANK YOU
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