



The Maritime Security Center (MSC)

**at Stevens Institute of Technology
Hoboken, NJ**

**Year 4 Work Plan:
July 1, 2017 – June 30, 2018**

July 17, 2017

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1. Overview and Mission Relevance

The Maritime Security Center (MSC) will develop both fundamental and applied research to support DHS's and other agencies' maritime security mission goals, including improved detection and interdiction capabilities, enhanced capacity to respond to catastrophic events, and a more secure and efficient marine transportation system. MSC will focus on interdisciplinary research, education, and technology transition in maritime security, maritime domain awareness, and extreme and remote maritime environment issues. The goal is to develop and transition research and technology solutions and educational programs to DHS maritime stakeholders to improve capabilities and capacities for preventing and responding to events in the maritime domain.

MSC led by Stevens Institute of Technology (SIT) is composed of a consortium of internationally-recognized research universities, including SIT, MIT, the University of Miami, the University of Puerto Rico, American Bureau of Shipping (ABS), Louisiana State University, Florida Atlantic University, and Elizabeth City State University. Henceforth in this document, MSC will refer to the efforts led by SIT and carried out with its partner institutions delineated above.

The MSC strategy to achieve its mission centers on the creation and sustainment of a truly collaborative research and education enterprise that draws on the strengths of each partner, as well as their leveraged relevant DHS and non-DHS research and education activities. We believe that these unique attributes – collaborative; integrated research & education; and leveraged relationships with Federal, State, local government, and industry stakeholders – positions the MSC for continued long-term success and impact.

DHS stakeholder components include U.S. Coast Guard and Customs and Border Protection. Specific areas articulated by the National Strategy for Maritime Security: National Maritime Domain Awareness Plan include priorities/gaps in dark vessel detection and tracking, anomalous behavior monitoring and information sharing.

The focus for Year 4 will be to issue an RFP soliciting new projects, facilitate transition of appropriate projects to DHS components, organize an annual meeting with DHS and relevant stakeholders, and report on the annual activities of the Center.

2. Management Plan

Extending the reach of MSC and facilitating the close collaboration of the faculty, research staff, and students of each partner institution, as well as the essential interaction with DHS, the component agencies, State and local agencies, federal laboratories, and other DHS Centers of Excellence, is a primary task of the Management Plan. Our management plan and organizational structure also ensure that the MSC

research and education activities will be relevant to stakeholders, with strong linkages to government customers and industry partners, and establish a pathway for transitioning knowledge, technology products, algorithms and processes that will be of use in the field.

The MSC management team includes:

- ❖ A Director/Principal Investigator
- ❖ A Deputy Director
- ❖ A Director of Education
- ❖ A Management Committee

Director/Principal Investigator: Dr. Hady R. Salloum, Associate Dean of Research and ECE Professor in the Charles V. Schaefer Jr. School of Engineering & Science at Stevens Institute of Technology will serve in this capacity. Dr. Salloum will function as the primary POC for the DHS Program Manager, and the primary liaison between the MSC team members and DHS and other Federal, State and local agencies as well as industry and non-governmental organizations. He will be responsible for the strategic direction of the MSC, and will serve as Chair of the Management Committee, which has the responsibility for evaluating project progress and providing input for the allocation of MSC resources. Dr. Salloum will also be responsible for overall quality assurance, and for the adherence of the MSC to all contractual obligations under the Cooperative Agreement, including information assurance, information sharing, ITAR/EAR regulations, IRB processes, and health and safety plans. Also, among the Director's responsibilities will be engagement with DHS Stakeholders, facilitating transition of projects that are ready, communications with DHS and its Stakeholders, and outreach to the Center stakeholders. At Stevens, the Director will report directly to the Dean, a reflection of the high priority of this position within the Stevens Administration.

Deputy Director: Assumes many day-to-day management of the Center, and is involved in all aspects of strategic planning and stakeholder engagement. Assists the Director in Center activities including the preparation of project reports, plans, proposals, meetings, conferences, and workshops, and the coordination of activities at the partner institutions, government labs, and other DHS Centers of Excellence (COEs). The Deputy will also assist in the preparation of new project Workplans (e.g., projects awarded via the RFP) and Annual Reports and scheduling and conducting face-to-face meetings and conference calls among MSC investigators, as well as all meetings with the MSC Science and Education Advisory Committee (SEAC), all Stakeholder meetings, and other meetings as requested by the DHS Program Manager or as deemed necessary by the Director. The Deputy also works closely with the Director of Education to coordinate outreach activities and to ensure that students are represented in research and stakeholder endeavors. The Deputy will also assist in the preparation, issuance, and

analysis of Center solicitations (White Papers and RFPs). This position will be filled based on funds availability.

Director of Education and Outreach: The Director of Education will develop the overall vision and strategy for the education programs of the MSC, including Undergraduate, Graduate, and Professional (including certificate) programs, summer experiential programs, and specialized technology transfer meetings, tabletop exercises and other short programs tailored to the needs of the DHS component agencies. The Director of Education and Outreach coordinates, organizes, and implements all education and training-related activities. She will also be responsible for all reporting of education and training-related activities of the MSC, to the MSC SEAC, the Stakeholders, and the DHS Program Manager. Working with the Management Committee and the individual Investigators, the Director of Education will also be responsible for the development of all publications and presentations related to education and training, and all education- and training-related proposals and initiatives. Additional responsibilities include the recruitment, retention, and subsequent placement of students in the various educational programs and in field-based internships and employment. As the lead for outreach, this person is responsible for Center communications, including the Center's newsletters, public and professional outreach engagements and networking opportunities, and coordination with the DHS communications personnel. Ms. Beth Austin-DeFares, Stevens Institute of Technology, will serve as the Director of Education and Outreach.

Management Committee (MC): The MC is responsible for top-level coordination of the MSC activities. The MC will be chaired by the Director and will consist of one representative from each of the partner institutions (typically the co-PI), along with the Deputy Director and the Director of Education. The MC will also include the DHS OUP Program Manager. The MC will be responsible for the review of MSC projects and the allocation of funds, and the responsiveness to the DHS biennial review.

The MC will meet by conference call approximately on a monthly basis, and face-to-face on a semi-annual basis when possible. The MC will facilitate – through their personal contacts within their own organizations – strong communication among the individual faculty, researchers, and students that make up the MSC, and responsive interactions with DHS and the various stakeholder communities.

Advisory Board (Science and Education Advisory Committee or SEAC). The SEAC consists of representatives from the maritime industry, relevant state and local agencies, academia, and national labs. The SEAC advises the MSC on present and future research projects and educational programs from the perspective of the current state-of-the-art in relevant science and technology, and present and future needs of the MSC stakeholders and end users. The current SEAC Members, listed below, will meet semi-annually face-to-face, or via conference call. We anticipate to review the current membership and identify potential new members to add or replace existing members:

- ❖ Admiral James Loy (USCG ret), Chair
- ❖ Vice Admiral Robert Parker (USCG ret)
- ❖ Ms. Lilliane Borrone, former Director of the Port of New York and New Jersey
- ❖ Mr. Steven Carmel, VP, Maersk Sealand
- ❖ Dr. John Montgomery, Director, Naval Research Laboratory
- ❖ Ms. Sidonie Sansom, Director of Security, Port of San Francisco
- ❖ Ms. Bethann Rooney, Assistant Director of Port Commerce, Port Authority of NY and NJ
- ❖ Dr. Martha Grabowski, Professor, Rensselaer Polytechnic Institute

Facilities

MSC is headquartered at Stevens Institute of Technology in Hoboken, NJ. The physical infrastructure of Stevens includes direct access to NY Harbor via the Hudson River, a more than 30,000 square foot ocean engineering laboratory complex that houses the most advanced towing tanks and wave tanks in the nation, two fully equipped coastal and estuary research vessels, a Maritime Security Laboratory for real-time data visualization, and an operational ocean and weather observation and forecasting system that covers the region from Nantucket Island to the Chesapeake Bay. Stevens makes available office space, meeting rooms, and conference facilities on its campus, which is conveniently located near three major airports and rail, subway, ferry and bus transportation systems. The space includes offices for the Director, Deputy Director, Director of Education, Administrative Assistant, as well as up to six visitor offices for use by individuals from the partner institutions, DHS, and other organizations. The meeting rooms and conference facilities can accommodate groups ranging in size from 20 to 400 people.

Project Solicitation

MSC will continue to engage with the DHS stakeholders to discuss their high priority challenges. To address these challenges, we will solicit proposals on a quarterly basis via White Papers or Request for Proposals. The topics, research questions and knowledge gaps solicited will be drawn from the Center's original Funding Opportunity Announcement (FOA) as well as the Integrated Product Team (IPT).

We will also continue to socialize the Center's projects and encourage existing and prospective partners to submit new ideas that can help the Center in its research and education missions. Such new ideas for projects will be considered for funding when resourcing becomes available.

In July 2017, the Center will issue a Request for Proposals (RFP). Additional information regarding the RFP, is addressed in section 4.4.

Project Evaluation

MSC will continue to measure its progress towards both its short- and long-term objectives through a formal review process. The research evaluation cycle begins with an annual call to the PIs to submit their planned project workplans. These plans will be reviewed by MSC's Director. This process will be interactive between the research leads (PIs) and the MSC leadership, where feedback will be provided on the technical relevance in the context of the overall Center's themes and projects. Corrective actions required will also be provided when warranted. The Director will be responsible for tracking post-project developments and for providing measurements of MSC's progress in transitioning. The Director of Education will be responsible for evaluating specific education programs using metrics described below.

The progress of each project will be discussed during the management committee meetings as well as other meetings with the PIs. Milestones and project metrics will be reviewed with the PIs on an ongoing basis and evaluated. Deviations/delays will be discussed with the DHS Program Manager, and corrective action will be taken.

Our overall evaluation goal is to have a clear understanding by the end of each year as to which activities will be continued, which need to be modified (and perhaps even expanded) and which need to be ended. The reviews will gather data on the following topics/questions and a detailed discussion will be undertaken to establish the continued viability of each project. The discussion will take place with the project PI, and feedback will be consolidated and supplied to the project PI in written format. We expect that the members of the management committee will actively participate in the evaluation of the data gathered, and in the preparation of the feedback to the PI. This process will rely on email correspondence, and phone calls as needed. The issues/questions that need more clarification and/or work progress to address any concerns will be undertaken at the subsequent review.

Project-based evaluation criteria we will assess (also relevant for biennial review) include the following to continue to evaluate whether each project is good science, it is relevant to the DHS stakeholders, and is progressing as planned. We will use the following questions as a guide:

- Do reported performance metrics and milestones indicate adequate progress towards meeting objectives?
- Is there alignment with DHS stakeholder research gaps and needs?
- Does the project formulation and progress demonstrate an understanding of related studies? Has the PI demonstrated an understanding of previous studies?
- Does the data acquired support the best available and is the data verifiable?

- Has the research contributed to scientific knowledge in relevant fields? Do the findings advance knowledge and do they address the needs of the users?
- Does the project have the potential to create operational efficiencies and/or buy down risk?
- Do the project teams contain an appropriate mix of interdisciplinary skill sets and partners needed to achieve the research objectives within the proposed timeframe?

On an on-going basis, the MSC management team will continue to encourage the PIs to contribute to the following activities, with the understanding that these activities are also considered indicators of the quality of the research projects in the portfolio:

- Publications and joint publications, refereed articles, technical reports, books, and presentations (target at least 1)
- Number of graduate students involved in MSC and MSC-related research (target at least 1, based on available funds)
- Adoptions of MSC products by end-users
- Student/faculty exchanges (when feasible)
- Collaborative conferences and workshops (number and attendance)
- Total funding from external sources
- Patents
- Copyrights and trademarks
- Transitions and commercialized products

MSC will take input generated by DHS and reflect this feedback in our education and research projects. In particular, feedback provided by the DHS biennial evaluation will be used to implement changes or corrective actions, as required. MSC management will begin at the outset to solicit research questions/needs from our DHS customers. Mechanisms to achieve input include stakeholder meetings and other forms of communication. We will avail ourselves of Center outreach mechanisms and will also attend closely to agency/division roadmaps and pursue data-mining to better understand both the technology gaps and the possible non-MSC research performers. Importantly, one possible benefit of this approach would be that the MSC can “buy down” the risk for certain identified areas of R&D being pursued by Division. Once we have identified the technology gaps and the areas of need, we plan to develop project proposals via White Papers or RFPs as needed.

A consolidated annual report will be produced detailing activities for the previous year, quantitative measurements of the progress towards objectives, and plans for the future. The annual report will detail the Center activities in the research, education and outreach areas that have occurred, specifically comparing outcomes with the lists of planned tasks detailed in the workplans. The MSC SEAC will be engaged to provide feedback on a semi-annual basis on the progress of the Center.

The following areas will continue to be monitored across the Center enterprise:

- Quality of research being conducted under various themes
- Relevance and operational impact of research on end-users
- Dissemination of findings, transition of products, and commercialization
- Diversity and work with Minority Serving Institutions (MSIs) and underrepresented communities.
- Education in homeland security, including graduate research support
- Production of homeland security researchers and professionals
- Outreach to other DHS centers; national laboratories; research and security organizations; and Local, State, and Federal agencies
- Organizational efficiency and management (streamlined processes – e.g., consolidated tracking of research progress, DHS research needs, and processes for new project initiation)

A discussion of the above bullets will be provided in the Center's Year 4 Annual Report.

An additional cluster of metrics relates to the ability of the aggregated MSC research projects to impact stakeholders. These metrics provide a synergistic integrated layer to the metrics listed above, but overall they represent a means of assessing the Center impact. The expectations will vary by project and stage of research, but overall include:

- Number of high-quality whitepapers produced for government/stakeholders to explain our research progress and/or experiments and outcomes
- MSC scientists used as Subject Matter Experts (SMEs) by stakeholders
- Advice and information provided to Federal, State, and local elected officials and decision-makers, via testimony and other means
- Joint activities with stakeholder organizations (conferences, committees, workshops, exercises, technology evaluations or deployments)

We will also have a cluster of Center-focused transition questions. These questions, which will be used to inform the various review processes, will include:

- How is the Center disseminating research results broadly to the public and to stakeholder end users to enhance their scientific and technological

understanding (metrics to include newsletter frequency and readership stats; dissemination of 1-pagers)

- Is the transition strategy and team composition adequate to ensure continued progress toward transition?
- How does the work stand on transition readiness path (e.g., USCG) (formal evaluation status)
- Is the activity sustainable over along enough duration to ensure transition?

Transition Plans

The MSC transition strategy begins with stakeholder guidance, stimulates and sustains interest and confidence in technologies throughout product development, and leverages existing partnerships with industry to ensure timely transition. The transition theme is always discussed with the DHS stakeholders, starting at the kick-off meetings. Our strategy has been including the following:

- interacting frequently with DHS stakeholders, primarily in the form of meetings and workshops, to repeatedly assess evolving needs and capability gaps;
- establishing a chain of trusted agents between the technology developers and end users to ensure delivery of robust, fit-for-purpose systems and provision of reliable technical and operational support from the component level up through the system level;
- engaging DHS stakeholders in joint ventures to the extent appropriate to ensure that dual-use and multi-use transition opportunities are fully considered and exploited. As an example, projects involving data collection have sought input from the DHS components to improve the product outcome and widen their applications to multiple components. The projects

being conducted during Year 4 will look for opportunities to continue to do this.

Since transition will be a focus for Year 4, the MSC management team will work with individual PIs to help them transition their projects. We will specifically assist them through the following steps:

- Work with the project champion to identify the receiving organization of the product within the DHS component
- Work with the project champion to identify the requirements of this organization to receive the product as well as the hurdles that need to be overcome (this includes security, platform, and other potential areas)
- Identify steps and vehicle needed to make product available (e.g., licensing, other specific tasks, etc.)
- Work with the project champion to identify the steps/actions that need to be taken once the product is received.

A key goal of MSC will be to transfer data and knowledge (e.g., via journal and trade publications) and envision ways to transition technology to end-users in an operational environment – including DHS components, and state and local government users. Building the chain of trusted agents and nurturing long-term relationships with the end user communities based on mutual trust and demonstrated performance is essential to the success of the technology transfer efforts. MSC will solicit DHS user input and feedback to help focus demonstrations of early research efforts and feasibility studies at Technology Readiness Levels (TRL) 1 to 3. This includes the Smart Port Resiliency Assessment and Planning Tool project. Likewise we envision field and/or tabletop experiments in support of the work described herein if new projects solicited through the RFP provide such an opportunity.

We note here that the Stevens Office of Innovation and Entrepreneurship is specifically chartered to facilitate technology transitioning, and this resource will be applied to assist MSC. In particular, this office will facilitate the development and execution of CRADAs, Memoranda of Understanding, Memoranda of Agreements, Licensing Agreements, patent disclosures, copyrights, etc.). Stevens Office of Innovation and Entrepreneurship includes individuals highly knowledgeable in intellectual property development, identification, protection, and commercialization. This office facilitated the commercialization of the Stevens passive acoustic underwater surveillance system in 2012. MSC will continue to work with this office to look for transition opportunities using all vehicles available.

For fundamental research, knowledge transfer will be accomplished via the traditional routes of peer review and dissemination. These will include conferences, proceedings volumes, books, and peer-reviewed articles in leading academic and professional journals. In particular, MSC will continue to submit abstracts and papers to the annual

IEEE Homeland Security Conference, the Journal of Acoustic Society of America, and other scientific conferences and journals as well as component proceedings (the US Coast Guard Proceedings). A key component of this effort will be to transfer data and knowledge quickly and directly to the user community – NOT via technical journal publications – but rather via short, user-friendly documents tailored to the audience and describing the latest MSC results, e.g., a technology demonstration experiment, a new deployment, or the adoption of a new process or methodology. The intent of these documents is to facilitate rapid information exchange and possible collaboration and end-user opportunities, thereby accelerating the adoption of the portfolio tools and technologies. We will also utilize outreach mechanisms such as newsletters and 1-page research summaries to facilitate this process and keep potential and existing end-users informed, on a project-by-project basis. We will also continue to create abstracts and fact sheets for new projects.

As knowledge transfer is also inextricably tied to education, MSC will continue to provide means, motive and opportunities for students to transition from academia into the DHS workforce and for members of the DHS workforce to participate in MSC activities as guest speakers and students.

Other Activities

The management team will continually review activities to ensure compliance with federal regulations as well as the terms of the Cooperative Agreement. The MSC team promotes a culture of safety. To that end, we will institute a regular review of the established safety plan by forming an independent panel of experts. Our USCG Auxiliary contacts and advisory personnel will be important resources on this topic, and we intend to insure that the safety priority is communicated and enforced at partner institutions through regular review of their practices and procedures. The safety plan and information protection plan will be reviewed/updated once per year or as warranted and distributed among the Center partners and students.

The MSC management team will organize MSC participation in the MSC annual meeting. The MSC will coordinate activities with other Centers of Excellence, including any joint activities, as appropriate.

3. Stakeholder Engagement

The MSC will be pro-active in working in close coordination with the DHS Program Manager to ensure frequent and ongoing stakeholder engagement. The management team has developed extensive contacts within the community, and has had more than seven years of experience in organizing and conducting highly impactful meetings, workshops and conferences. An objective for this year is to facilitate transition of

appropriate projects to the DHS stakeholders and components. The transition theme will be discussed in all engagements. The following summarizes the plans for stakeholder engagement over the period of performance of this Workplan. Note that student internships, the Summer Research Institute, and participation in the workshops/meetings below will be the primary means of engagement of our students with the stakeholder organizations.

Stakeholder Engagement Meetings

The stakeholder engagement meetings will be held at various locations, including Stevens, the USCG Research and Development Center (RDC), and partner university campuses. Stakeholder Meetings will engage a broad array of USCG representatives (from Sector, District, Area, Headquarters, Academy and Fellows), other DHS components (Borders & Maritime, CBP and CBP Air and Marine Operations Center), and other federal stakeholders such as National Maritime Intelligence-Integration Office (NMIO), JIATF-S and National Urban Security Technology Laboratory (NUSTL), Navy and NOAA. Regional and local stakeholders such as Port Authority of NY/NJ, NYPD, NJ Office of Homeland Security and Preparedness (NJOHSP), NYC Office of Emergency Management are expected to attend as well. The meetings may also include industry representatives and academic partners, depending on the topics being covered.

A key objective of the stakeholder meetings is to gain insight on user needs. The purpose of the meetings is to present our research and transition progress in a manner that connects it directly to the potential end-users. The Stakeholder Engagement Meetings will be up to a day-long event, combined with other meetings when appropriate (e.g., workshops, annual meeting, etc.) and cover the following topics:

- A brief review of the progress on select Center projects, along with a report on the transition activities and plans related to each project.
- Feedback will be solicited from the attendees both at the time of the meeting and as follow-up by phone, e-mail, or by survey.

A goal of the meetings is to actively track the stakeholder response and make adjustments accordingly. The Stakeholder meetings are also valuable to identify potential challenges in transitions of projects downstream so we can anticipate and adapt/respond ahead of time. These discussions will be documented and reported in summary in the Year 4 Annual Report.

DHS Science and Technology (S&T) Outreach Events

MSC will participate in at least one DHS S&T outreach event to showcase our activities, tools and technologies and solicit feedback from potential end-users.

Other Stakeholder Engagement

MSC will seek a variety of other formal opportunities to interface with stakeholders such as Technical Interchange Meetings in coordination with the Coast Guard RDC, engaging in local Area Maritime Security Committees activities, meetings to work with our local law enforcement partners (e.g., NYPD, NJOHSP, and PANYNJ), and coordination and information exchange opportunities with the DHS National Urban Security Technology Laboratory, Sandia National Labs, CBP AMOC, among others. These meetings may include coordination on specific projects or opportunities to develop potential new projects.

Meetings of the MSC Science and Education Advisory Committee

MSC will invite the SEAC to its annual meeting to the Stevens campus/Washington DC office or at the location of one of our partner organizations. We will also invite the members of the SEAC to some of the activities described above, as deemed appropriate.

Faculty Exchanges

We will ask the project leads and other faculty to participate in exchanges to stakeholder environments with a target of 1 exchange, if all resources are available. Venues could include USCG operational settings or headquarters. Through these exchanges, MSC researchers would gain exposure to how the entity conducts its day-to-day operations in the mission space. Exchanges will last a week or longer, and may include longer-term faculty sabbaticals.

Engagement with Potential User Groups

MSC research and education efforts will build upon existing collaborative, interagency and interdisciplinary relationships. In addition to the Port of NY and NJ, the MSC will work with several U.S. ports, including the ports of Los Angeles, Houston, New Orleans, Seattle, Honolulu, Everglades, San Juan, Miami, and San Francisco. Several organizations currently interact with MSC on a regular basis to determine the homeland security needs of individual critical infrastructure locations and their interdependencies to the region, and representatives of these essential organizations are often members of the MSC SEAC. For example, MSC has been involved with the NJOHSP to determine state and local homeland security needs and we have engaged in organized exercises as evaluators and participants. These activities will be continued and expanded. MSC will also work with local Area Maritime Security Committees (AMSC), an essential element of the DHS national strategy to prevent terrorist attacks, mitigate natural disasters impact, and reduce vulnerabilities to port safety and security.

Future engagement efforts will focus on expanding partnerships with DHS via CBP and ICE as well as increasing MSC's strong collaboration with USCG. We will also engage with the national labs. We will continue a multi-pronged approach to introduce MSC personnel and capabilities to new partners via:

- Meeting in small groups at their facilities to discuss their needs and capability gaps;
- Inviting them to participate in MSC workshops and annual meetings; and
- Attending broader meetings in their fields or at their local venues that pertain to homeland security.

4. Research Projects

The MSC research projects are conducted in areas related to maritime security, including Maritime Domain Awareness, Maritime Cyber Security, and Port Resiliency. The research activities to be conducted are outlined below.

- Smart Port Resiliency Assessment and Planning Tool (FAU)
- Maritime Cyber Security (ABS)
- VTS Radar Research (Stevens Institute of Technology)
- Other Projects (TBD – Solicited via White Papers and RFP)

In the following sections, we describe the activities to be conducted during the period of performance of the Workplan. For each project, the PI will be asked to develop a viable transition plan with the help from the Center as described in the "Transition Plans" Section above.

4.1 Smart Port Resiliency Assessment and Planning Tool

Florida Atlantic University
Lead Researcher: Manhar Dhanak

The development of the port resiliency tool is well underway. The basic elements of the required port simulations on the Aimsun platform have been completed. Validations of the waterside and landside models have been initiated. We are in the process of developing a model linking and combining waterside and landside models, and analyzing stakeholder surveys. This will lead to the development of a single platform, and the development of best practice guidelines. These activities will be completed and a report, including lessons learned, will be prepared during Year 4.

Once completed, the tool will provide measures of effectiveness for port operations and landside and waterside traffic inside the port. It can be used to quantify consequences of a disruption at a port for different levels of disruptive events and for various levels of

port resiliency, including length of disruption, and recovery times, as well as traffic impact in the vicinity of the port.

Identified Tasks and Schedule

The following tasks and associated schedule are identified, building on work completed/underway:

1. Complete validation of waterside and landside models and analysis of stakeholder surveys [To be completed 7/1/17 – 8/31/17].
2. Complete model linking the waterside and landside models, combine the three models leading to a single platform [To be completed 7/1/17 – 9/30/17].
3. Prepare final report [To be completed 9/1/17 – 10/31/17].

Performance Metrics:

Anticipated milestones with proposed performance metrics are provided below:

<u>Milestone</u>	<u>Performance Metrics</u>	<u>Timeline Target</u>
1. Completion of validation of waterside and landside models.	Predictions based on the models validated against available historical data of port closure over a period of time.	Aug 31, 2017
2. Completion of analysis of stakeholder surveys and development of best practice guidelines and port resilience	Consensus feedback from port security personnel and port security specialists to the best practice guidelines developed.	Sept 30, 2017
3. Completion of a single platform through combining waterside and landside models	Final tool based predictions of the impact on and recovery of port capacity validated against available historical data of a port closure over a period of time.	Sept 30, 2017

<u>Milestone</u>	<u>Performance Metrics</u>	<u>Timeline Target</u>
4. Completion of a final report.	Acceptance/dissemination of the report, publication of results in a technical journal and at a conference, and delivery of algorithms, surveys and related materials to DHS.	Oct 31, 2017

4.2 Maritime Cyber Security Project

American Bureau of Shipping
Lead Researcher: Cris DeWitt

The following sections outline our planned research tasks for Year 4. The project involves research associated with 6 research questions as described below.

	Research Question	Status
1	Risk-Based Performance Standards	Complete
2	Framework for Cyber Policy	Complete
3	Critical Points of Failure	In Progress
4	Requirements for Maritime Cyber Range	In Progress
5	Framework for Point of Failure Detection Methodology	Complete
6	Maritime Cyber Deterrent Strategy Effectiveness	Not Started

Question 3. Critical Points of Failure

Based on a multi-node analysis, what are the critical Points of Failure within the cyber system supporting the MTS?

Tasks

1. **Doctrine Review.** We will leverage the review of key maritime cyber risk management doctrine (Question 1, Step 1) to identify scenarios of concern and the associated definitions to develop an understanding of criticality thresholds. We will then meet with USCG, DHS, and DoD decision makers to clearly define “critical points of failure” and identify “criticality thresholds”. These definitions should address aspects of system vulnerability of and potential consequences of system exploitation (e.g., physical consequences).

2. **Asset Class Screening.** We will identify the subset of asset classes with cyber scenario consequence potential exceeding the criticality threshold.
3. **General Architecture Development.** We will develop general architecture profiles for each of the asset class based on the common systems identified in Question 1, Task 5. These will address both IT and OT systems and integration.
4. **Corruption Vector and Penetration Point Taxonomy.** We will develop a hierarchical taxonomy of corruption vectors and their associated penetration points. We will then map the potential corruption vectors and penetration points for each general architecture.
5. **Scenario Development.** For each general architecture/asset class combinations, we will identify specific scenarios that could result in consequences above the criticality threshold.
6. **Risk Assessment.** We will perform a high level risk assessment considering threat, vulnerability, and consequence factors. Due to the general nature of the assessment, we will choose a qualitative or simple quantitative risk methodology to assess the risk. Methods may include bow tie, event tree/fault tree, or preliminary risk analysis.
7. **Results Documentation.** We will document the results of the risk assessment process, identifying critical points of failure and articulating them as a function of asset classes, systems, corruption vectors, and penetration points.

Deliverable		Target Date
2	Points of Failure Analysis Report	Aug 2017

Question 4. Maritime Cyber Deterrent Strategy Effectiveness

What are the critical requirements that should be considered when developing an academically rigorous and multi-use Maritime Cyber Range?

Tasks

1. **Use Case Development.** We will first investigate known cyber range models (e.g., U.S. Marine Corps, ABS) to determine their relevance and applicability to this project. We will interview representatives from the most relevant ranges to discuss lessons learned and best practices. If needed, we will host a workshop with maritime government representatives to discuss findings and define cyber range objectives for this project. Based on workshop guidance and scenarios of interest identified in task 3, we will document methods for developing use cases.

2. **System Behavior Definition.** We will document methods for developing expected system behavior definitions (including integration among systems) for systems of interest
3. **Test Boundary Development.** We will document methods for developing test boundaries for select architectures
4. **Test Requirements.** We will document methods for defining test requirements
5. **Equipment and Software Requirements.** We will document methods for developing test equipment and software requirements.
6. **Test Documentation.** We will document methods for recording and interpreting test results
7. **Develop Training Requirements.** We will document competencies that users of the range require to conduct experiments. Competencies will address all phases of the experiment, including, but not limited to: initial range configuration, conduct of the experiment, results documentation, and procedure for returning range to baseline state.

Deliverable		Target Date
7	Cyber Range Requirements Report	Feb 2018

Question 6. Maritime Cyber Deterrent Strategy Effectiveness

What methodologies can be employed to conduct a quantitative analysis of maritime cyber deterrent strategy effectiveness?

Tasks

1. **Define Current Cyber Deterrent Strategy.** We will meet with government representatives to capture the elements of their current cyber strategy and means they use to develop strategy and measure effectiveness. We will document the multi-layer strategy in a comprehensive framework, likely using bow-tie methodology.
2. **Decision Definition.** We will then define key decision makers (e.g., government leaders, asset owners) who will use of the cyber deterrent strategy effectiveness measurement model. For each decision maker type, we will identify the decisions to be supported by results of methodology. This will include the options available to the decision maker.
3. **Information Requirements.** We will identify the types and quality of information that is required to support each decision.

4. **Methodology Identification/Development.** We will identify a relevant methodology capable of generating the required information. We will tailor it to meet the information requirements.
5. **Model Development.** We will develop a prototype model based on the chosen methodology.
6. **Perform Analysis.** We will populate the model with data for a representative scenario.
7. **Document Results.** We will document the details of the model, summarize the analysis results. We will recommend any identified enhancements to the relevant methodologies.

Deliverable		Target Date
8	Cyber Deterrence Effectiveness Model	Jan 2018
9	Cyber Deterrence Effectiveness Model Analysis Results Report	Feb 2018

4.3 VTS Radar Research

Stevens Institute of Technology
 Lead Researcher: Bruce McNair

Project Description

The US Coast Guard uses a Vessel Traffic Service (VTS) system to collect, process, and disseminate information on the marine operating environment and maritime vessel traffic in major U.S. ports and waterways. The PAWSS (Ports And Waterways Safety System) VTS mission is to monitor and assess vessel movements within a VTS Area, exchange vessel movement data with vessel and shore-based personnel, and provide advisories to vessel masters.

The VTS system at each port has a Vessel Traffic Center that receives vessel movement data from the Automatic Identification System (AIS), surveillance sensors, other sources, or directly from vessels. AIS technology relies upon global navigational positioning systems (GPS), navigation sensors, and digital communication equipment operating according to standardized protocols (AIS transponders) that permit the exchange of navigation information between vessels and shore-side vessel traffic centers. AIS transponders can broadcast vessel information such as name or call sign, dimensions, type, GPS position, course, speed, and navigation status.

While AIS is helpful, not all vessels are required to use AIS (only certain vessels that fall under certain categories for gross tonnage, passenger capacity, length, and function are required to carry and use AIS). Also, the majority of currently installed radars detect vessels with a minimum size where smaller vessels and other objects that have too small

of a Radar Cross Section are not seen in the background of clutter. Therefore, a means is needed to detect these small and large vessel targets that are either not required to carry AIS or not cooperative (i.e., they do not comply with AIS required use or spoof AIS information).

Methodology

As a first step, we propose to conduct a market survey to learn about commercially available solutions that have been developed to address this. In particular, we will research and document open source information for commercial solutions that provide clutter suppression methods to improve radar performance. We will also survey standards and integration patterns that are applicable in this area.

Once the commercial solutions are understood, we will examine radar raw data that contains all the detected information, including small targets and unwanted clutter.

The objective of this research is to help DHS stakeholders in their operational missions to identify suspicious small vessels that may be present in a harbor or port. It addresses one of the Secure Borders Integrated Product Team (IPT) gaps (see <https://www.dhs.gov/science-and-technology/ipt>) as well as questions provided in the Center FOA. These questions are:

- What existing technologies can be applied to effectively improve surveillance, detection, classification, and identification of vessels, suspicious materials, and persons in the maritime domain both on and below the water?
- What new technologies, including technologies combined with new non-technological inspection methods and tools, can effectively improve a user's ability to screen, detect, and mitigate threats?

The USCG has invested in many VTS/PAWSS installations around the US ports. Although their objective is to detect large vessels using Terma based radars, the raw radar data could contain detections of small vessels as well. The objectives of this proposal is to:

1. Perform a market survey for software standards, integration patterns and security requirements that are applicable in this area (Milestone 2);
2. Investigate various industry standards for exchanging real-time radar data such as NMEA OneNet and Asterix (Milestone 3);
3. Investigate and document existing commercially viable systems for clutter suppression methods for improving radar performance through open source information (Milestone 4);
4. Investigation of new algorithms and known signal processing algorithms and sea clutter suppression methods that can provide longer range of small boat detection (Milestone 5).

Milestones

The following describes the milestones along with the schedule.

Milestone	Description	Outcomes	Time Frame
1	Kick-off meeting with key stakeholders from DHS, CBP, and USCG.	Meeting notes	Within 30 days of start date
2	Survey of software standards, integration patterns, and security requirements	Draft 1 Summary Report	07/31/2017
3	Investigation of the application of NMEA OneNet, Asterix formats, and other National Marine Electronics Association (NMEA) communications protocols for organizing the radar network and for data fusion with information from other sensors (like AIS and Maritime CCTV surveillance).	Draft 1 Summary Report	07/31/2017
4	Investigation of existing commercially viable systems for clutter suppression methods for improving radar performance through open source information	Draft 2 Summary Report	10/31/2017
5	Investigation of new algorithms and known signal processing algorithms and sea clutter suppression methods that can provide longer range of small boat detection.	Draft 2 Summary Report	10/31/2017
6	Documentation of all findings	Final Summary Report	11/30/2017

Performance Metrics

The following performance metric will be used for this project:

ID	Description	Quantitative Target	Achieved By
1	Review known and suggest new methods of signal processing for extraction of radar signatures.	At least 3 various methods for detection distance increasing and sea clutter suppression applied for boats with RCS under 10 m ² will be investigated and compared	09/30/2017

DHS Stakeholder Engagement

At no time will it be necessary to interface directly with any operational USCG or CBP assets. The research team will engage with appropriate DHS S&T personnel who will be the conduit to DHS components if needed. DHS S&T will invite appropriate stakeholders to participate in the kickoff meeting to go over the project and expected outcomes and any other status meetings held throughout the project.

A final report will be included that documents all data collected, results, metrics and conclusions.

Benefits to DHS Stakeholders

This project investigates the use of existing assets for providing needed data for various missions of the USCG, CBP, ICE and other DHS stakeholders involved in maritime security. Leveraging existing radar capabilities as opposed to the installation of new equipment provides substantial cost savings to DHS stakeholders for small vessel detection, an essential element of maritime security and law enforcement missions. It is important to note that connectivity between the VTS processing system and other potential DHS users may be a challenge due to the various missions for the DHS component agencies. For instance, if the VTS sensors could become multi-mission without comprising the legislated VTS mission, detection of small and dark targets could be done within the existing VTS radar coverage. Sharing such information among multiple DHS component agencies would be of great benefit. It is also important to note that the radar data provided may not be adequate (i.e., small vessel data is not present). In the absence of data or good data, Stevens will seek input from other sources for this project in collaboration with the stakeholders. If this step does not lead to good data, then Stevens, together with the stakeholders and PM will determine the next course of action.

4.4 Other Projects

MSC will be soliciting new projects via a call for proposals in the form of a Request for Proposals (RFP) and a request for White Papers. The RFP will solicit proposals that address current stakeholder research questions (mostly derived from the Center Funding Opportunity Announcement). The call for White Papers will solicit new ideas that have not been addressed in the RFP to allow for projects that provide innovative research approaches that show potential promise in addressing the DHS Stakeholder concerns.

During Year 4, the RFP process (along with evaluation) will be conducted and a Request for Proposals will be issued, and the proposals will be evaluated. The effort will invite qualified researchers to propose projects that will provide DHS stakeholder with innovative research that addresses critical issues in the following theme areas:

- Maritime Risk, Threat Analysis, and Resilience Research;
- Maritime Domain Awareness (MDA) Research;
- Maritime Technology Research
- Integration of Science and Engineering with Maritime Security Governance and Policy Research.

MSC will specifically fund research for the purpose of improving the safety, security, and resilience of the maritime domain with the expressed outcome of improving the Nation's homeland security.

Proposals will be reviewed by the Center's Scientific Committee comprised of representatives from public and private sectors and academia. Projects recommended for funding will be scored, ranked and forwarded to DHS for mission relevancy and for final approval. Proposals that are interdisciplinary, highly collaborative and have strong potential for transition to the end user are encouraged.

5. Education and Outreach

Overview

MSC is committed to enhancing the knowledge, technical skills and leadership capabilities of the Nation's current and prospective maritime security workforce. At the core of the MSC's mission, is the transfer of its research and expertise into relevant, innovative maritime security-centric educational programs. The Center's educational programs leverage the subject matter expertise, teaching talent's and research assets of its academic partners to provide multidisciplinary and experiential learning opportunities for students, professionals, stakeholders, and the general public.

During Year 4, the Center's academic partners will each contribute to the MSC's educational programs, by providing guest lectures, contributing their subject matter expertise, or through the inclusion of their university's students in the Center's Summer Research Institute and Fellowship programs. The MSC's partners will also conduct outreach to promote the Center's educational activities and opportunities for HS-STEM focused students and professional development opportunities for homeland security practitioners. Outreach efforts will include the distribution of MSC program literature, electronically or in hardcopy, to increase the awareness of the Center among their student populations and their local and regional homeland security contacts. The Center's educational programs for Year 4 will include the following:

College-level experiential learning and research-based programs:

- The Summer Research Institute
- Fellowships and Research Assistantships
- MSI Engagement and Outreach

Project 1.1 The Summer Research Institute

A. Project Description

MSC has developed an eight-week intensive HS-STEM focused summer research program designed to expose students to the maritime and homeland security domain and to engage them in research projects tailored to address critical issues in maritime domain awareness, emergency response and maritime system resilience.

With the inclusion of its academic partners, MSC will continue to build upon its successful Summer Research Institute and will expand its outreach to encourage student participation from each of the Center's academic partner schools. The Center will also maximize its efforts to conduct targeted recruitment from MSI schools to ensure diversity in the program and to facilitate enhanced opportunities for women and students from underrepresented communities.

This coming summer (June 5 – July 28, 2017), MSC plans to host over 20 students from seven U.S. colleges and universities, including two MSI schools. The Center aims to continue the annual delivery of the program during the months of June and July during the 2017/2018 academic year.

B. Benefits to DHS Stakeholders

Prospective HS-STEM students: The summer research program engages STEM students in hands-on multidisciplinary research projects focused on critical issues in maritime security. The program exposes students to homeland security concerns and to new academic opportunities and careers within the homeland security enterprise. Students enhance their professional development by actively engaging in team-based projects, collaborating with academic researchers and networking with homeland security practitioners.

Homeland Security Enterprise: The Summer Research Institute provides a forum for high-achieving STEM students to network and engage with homeland security practitioners in the public and private maritime sector. The program provides opportunities for homeland security practitioners to contribute to the development of relevant security research projects and to the education of the future homeland security work force.

C. Methodology

Feedback from past student surveys and discussions with Center researchers and stakeholders have identified the following activities to have had tangible, long-term impacts on student participants, and will serve as the ongoing framework for the program:

- Participation in seminars provided by MSC research members, Stevens faculty members, and homeland security practitioners.
- Engagement in hands-on, multidisciplinary research projects focused on current maritime and homeland security issues.
- Field-visits and field-based activities with Federal, State, and Local homeland security practitioners. (e.g., USCG, CBP, NJ OHSP, NYPD-CTD and NUSTL)
- Professional development activities, including oral presentations, team projects, report writing, and networking.

Lessons learned over the seven-year delivery of the Summer Research Institute will continue to inform and guide the implementation of the program in Year 4.

MSC researchers play a key role in the professional development and mentoring of SRI participants. Students in the 2017 and 2018 programs will be given the opportunity to learn first-hand from experienced researchers in the fields of maritime security, cyber security, and remote sensing and surveillance. Students will be given unique access to cutting edge tools and technologies, data sources and an extensive network of industry and government homeland security experts and stakeholders.

The goal of the SRI program is to further connect students with homeland security stakeholders and to engage them in research projects that are responsive to and directly impact the knowledge and technology needs of homeland security practitioners. During Year 4, the summer research program will build upon the Center's ongoing research to enhance maritime domain awareness (MDA) and will incorporate the Center's emerging projects in the areas of Maritime Cybersecurity and mobile MDA platforms. SRI student participants will contribute to the advancement of the Center's research and tool development through the summer research program and will assist in the transition of the Center's work through field-based activities and engagements with MSC's stakeholders.

The annual SRI will be organized and coordinated by MSC Director of Education, Beth Austin-DeFares, in conjunction with Dr. Barry Bunin (Director, Stevens Institute of Technology Maritime Security Program). Ms. Austin-DeFares serves as the primary program facilitator, while Dr. Bunin participates as the lead faculty facilitator and curriculum developer. Dr. Bunin will also provide the day-to-day SRI student team mentorship, along with other MSC research PIs and Stevens faculty. In addition, Dr. Bunin will serve as the overall technical lead on the SRI projects and provide assistance to students in both theoretical and practical implementation of the projects.

D. Project Milestones

1. Featured lectures by MSC researchers and invited guests (e.g. USCG, NYPD-CTD). (6/5/17 – 7/28/17) / (6/4/18 – 7/27/18)
2. Field-visits and field-based activities. (6/5/17 – 7/28/17) / (6/4/18 - 7/27/18)
3. Diversity of student participants. (6/5/17 – 7/28/17) / (6/4/18 – 7/27/18)
4. Research Reports, presentations and posters. (6/5/17 – 7/28/17) / (6/4/18 – 7/27/18)
5. Post-Program Student Survey. (7/17/17 – 8/4/17) / / (7/16/18 – 7/27/18)

E. Performance Metrics

The performance metrics are mapped to the milestones listed above.

1. A minimum of three homeland security/maritime industry guest speakers will be hosted during the summer research program:
 - 1a. A minimum of four faculty lectures will be provided during the eight-week research program.
 - 1b. The quality of and knowledge learned from the lectures will be assessed through a post-program student survey.
2. Students will engage in a minimum of two field-based activities during the summer research program. (e.g., participation in a stakeholder meeting/workshop/training, research experiments/deployments, operational facility tours) during the program.
 - 2a. Impacts of the field-based activities and stakeholder engagements on student professional development and networking skills will be assessed through a post-program student survey.
3. Diversity will be measured according to the number of students from underrepresented communities (MSI schools, minority students and women), and to the number of STEM disciplines represented in the program. A minimum of four different disciplines will be represented.
 - 3a. Student diversity will be measured by the percentage of women and minority students participating in the program. A diverse student population will include a minimum of 50% students from underrepresented communities. (e.g., women, students attending MSI's, or minority students.)
4. A minimum of two research summary reports and research posters will be prepared at the culmination of the SRI program.
 - 4a. Students will engage in four research status update presentations (Weeks 3 – 7) during the SRI.

- 4b. Stakeholder engagement will be assessed by the inclusion of homeland security representation in the student’s research activities (field-based, in the classroom, interviews) and in attendance at the student’s final research presentations.
- 4c. Quality of research outcomes will be assessed by MSC research mentor feedback and the number of projects submitted for presentation at conferences and/or for publication.
- 4d. Program impacts on professional development, technical skills learned, project teamwork, and expressed student interest in advanced academic study or careers in HS-STEM will be assessed by a post-program student survey.

5. A minimum of one student survey will be conducted at the end of the 2017 and 2018 SRI programs. The survey will be used to measure the strengths of the program and areas for improvement.

F. Outputs/Outcomes

MSC will provide a structured eight-week summer research program for STEM students to engage in hands-on homeland security-focused research. The program consists of faculty and invited guest lectures and field-based activities, and professional skills development exercises. Outcomes from the program will include student exposure and awareness to maritime and homeland security concerns, enhanced oral presentations skills, multidisciplinary project teamwork, and research reports and posters articulating the student’s research activities and knowledge learned.

G. Transition Plans

Student team final summary research reports and presentation slides will be made available on the MSC website. The Center also actively pursues post-program opportunities for students to present their work at national conferences and DHS affiliated events.

Ongoing effort is also made to connect SRI program students and alumni with internships, scholarships and fellowships, and employment in the homeland security enterprise.

H. Stakeholder Engagement

Stakeholder engagement in the SRI has been a key facet to the summer research program since its inception. Representatives from the USCG (Sector New York, Research and Development Center), NYPD (Counterterrorism Division) and Customs and Border Protection (Field Operations) have offered their support and participation in the Year 4 summer research program through the following activities: hosting field-visits and

facility tours (CBP Field Operations- Port of New York/Newark), engaging student's in training (NYPD-CTD's Port Awareness and Response training course), and guest lectures (NYPD-CTD, USCG RDC).

Potential risks to completion: The SRI program occurs over an eight-week period. While past student groups have achieved significant outcomes, research progress and outcomes rely upon the availability of research assets (e.g. working and available equipment (passive acoustic systems, teaching expertise, etc.). In past cases where needed technologies have been broken or deployed, we have relied upon archived data sources and tools and technologies loaned to us from other Stevens departments. SRI mentors and administrators are flexible and agile to ensure that students are provided with alternative resources as needed throughout their research experience.

Project 1.2 Fellowships and Research Assistantships

A. Project Description

Leveraging the support of DHS Education Supplement awards and DHS Career Development Grants the Center has developed a highly-engaged Research Assistantship and Master's Degree and Doctoral Degree Fellowship program. The homeland security-focused Fellows/Assistantship program provides for full-tuition support, a monthly stipend, attendance at national conferences, robust networking opportunities with homeland security decision makers and practitioners, and field-based internships for select students.

During the 2016/2017 academic year, the Center provided support for five fulltime enrolled students, including one Master's Degree Fellowship student, two Doctoral Degree Fellowship students, and two Research Assistantship students.

Of the five supported students, two completed their degree requirements in May 2017, and the remaining three students will fulfill their degree requirements during the 2017/2018 academic year. Funds remaining from Year 3 as well as funds requested for 1 student will be used for the three remaining students to complete their degree requirements.

During Year 4, the Center will utilize remaining funds in the Maritime Systems Fellowship program to provide support for one Homeland Security-focused graduate-level from Stevens School of Engineering and Science.

B. Benefits to DHS Stakeholders

HS-STEM career focused students: The Research Assistantship and Fellowship programs provide HS-STEM career focused students with a unique opportunity to complete their

coursework on a full-time basis and to engage in hands-on multidisciplinary research projects with MSC research PIs and Stevens Institute of Technology faculty members. The respective programs facilitate opportunities to gain invaluable experience through hands-on research and extensive networking opportunities and interactions with homeland security practitioners.

Homeland Security Enterprise: The rigorous HS-STEM Research Assistantship and Fellows programs engage students in engineering coursework, hands-on research in the context of maritime and homeland security concerns, field-based activities within the homeland security enterprise, and capstone senior design projects and homeland security-focused thesis preparation. The MSC program is committed to creating a steady pipeline of highly-skill STEM students entering technical leadership positions within the maritime and homeland security domain.

Project 1.3 MSI Engagement and Outreach - TBD

A. Project Description

MSC aims to connect faculty and students from Minority Serving Institutions (MSI) with the Center's research PIs, projects, assets, and technical expertise in the maritime domain. As part of the Center's ongoing commitment to enhance the HS-STEM research capabilities and educational opportunities of MSI faculty and students, the Center will leverage the subject matter expertise of its PIs and affiliate faculty members from Stevens Institute of Technology to deliver a workshop focused on issues of concern and interest to urban communities in the Port of New York/New Jersey geographical area. Workshop topics may include one of the following areas of interest:

- Urban Coastal Communities – Tools, technologies and best practices to enhance safety, security and resilience.
- Smart Cities, Citizen Science and STEM – Techniques for inspiring citizen and student participation and interest in environmental data collection and analysis.
- Port Awareness – Understanding the economic significance of U.S. Seaports to the local, national and global economy.

B. Methodology

The framework for the interactive workshop will include faculty-led seminars, group discussions, and instructional techniques and strategies for integrating the workshop topic into MSI program curriculums. Participants will receive resource materials and lesson plan development support. Opportunities for research collaboration will also be discussed.