Maritime resilience

In 2004, Stevens Institute of Technology, with support from the US Office of Naval Research, established the Stevens Maritime Security Laboratory (MSL), the goal of which has been to create a national laboratory resource for government, industry and universities to develop technologies for the protection of the US Naval maritime infrastructure.

The research undertaken in this area has also shown itself to be extensible to the protection of other high value assets as well, such as power plants and maritime structures. This is enabled by the pursuit of a diverse range of relevant research projects, including the development of maritime surveillance systems based on numerous emerging technologies; underwater communication; risk assessment; behavioural analysis; and complex decision-making.

The uniqueness of MSL lies in its ability to conduct experiments in the Hudson-Raritan Estuary itself. The estuary embodies the full range of natural and man-made complexities: as a tidal estuary its characteristics are continually changing and man-made factors include noise due to boats and ships, heat from power plants, and so forth. The complexity of the estuary requires that models, methodologies, and analyses be driven by real data, and then verified experimentally via actual estuarine experiments. Unique capabilities are then achieved through the integration of these methodologies with other technologies into prototype systems.

Furthermore, and most significantly, MSL is providing the education and development of future Anti-Terrorism/Force Protection (AT/FP) professionals and technology development leaders.

No doubt, these factors were considered carefully when the US Department of Homeland Security (DHS) earlier this year declared Stevens and MSL to be a National Center of Excellence in Port Security. Stevens was selected as one of 11 universities to conduct multi-disciplinary research and create innovative learning environments for critical homeland security missions. As an academic partner leading one of five new Centers of Excellence, Stevens will receive a multi-year grant of up to $2 million per year, over a period of four to six years.

The five new Centers of Excellence, located across the United States, will study border security and immigration; explosives detection, mitigation, and response; maritime, island and port security; natural disasters, coastal infrastructure and emergency management; and transportation security.

To accomplish the specific tasks set by the DHS, Stevens’ MSL will greatly expand the scope and variety of its research programmes. During the last four years, MSL has addressed itself to a broad range of possible threats, some subsurface, others sea- and airborne.

Techniques to detect these threats are active MSL research areas. Types of threats might include, for example, the introduction of biological and chemical contaminants or pathogens into the estuary. For all of these, detection and response require a thorough understanding of estuarine environmental factors such as currents, water level, salinity, surface waves, and temperature, and an ability to predict...
their changes.

There are three major assets used to support MSL research. The first is the MSL laboratory itself, which acquires its data from the estuary through the use of permanently-installed sensors, as well as experiment-specific sensors. During experiments, data is acquired and stored on special purpose computers on board Stevens' research vessels. This information is transmitted via radio to the MSL Visualization and Analysis Center on Stevens' campus from which experiments are controlled. Here the data is analysed in real time, as well as stored for post-processing.

The second major asset is the Stevens Wave Tank, a 100-metre-long structure used primarily for naval architecture and engineering research, which has been extended to MSL research as well. This gives MSL a year-round water-based research facility, as well as a more controlled environment to complement river-based experiments.

And the third is the New York Harbor Observation and Prediction System (NYHOPS). NYHOPS provides the real-time environmental knowledge and forecasting that are key to AT/FP activities. Knowledge of river currents, for example, is key to an understanding of where an underwater threat might or might not be able to travel, or the speed and direction of a pathogen release.

The Center for Secure and Resilient Maritime Commerce (CSRMC) will bring together a unique set of academic institutions and public and private sector partners with diverse expertise and significant experience in developing new knowledge, models, tools, policies and procedures, and education/training methodologies related to global maritime security and coastal safety.

Stevens' academic partners include Rutgers University, the University of Miami, the University of Puerto Rico, the Massachusetts Institute of Technology (MIT) and Monmouth University. Non-university partners include JBC International, Lockheed Martin Maritime Systems and Sensors, the Port Authority of New York and New Jersey, the Pacific Basin Development Council and the Nansen Environmental Remote Sensing Center. A strategic Federal partner is the US Merchant Marine Academy's Global Maritime and Transportation School.

The Center partners have expertise in national Marine Transportation System (MTS) policy, ocean engineering, maritime security, marine sciences, satellite and radar remote sensing, marine transportation and logistics, systems engineering, oceanography, computer science, naval architecture, physics, sociology, psychology, US and international law, and economics.
The partners have worked together on numerous US and international projects related to the safe, secure and environmentally responsible transit of cargo and passengers via the MTS, as well as the short- and long-term impacts of coastal hazards on socio-economic systems, ecosystems and living marine resources. The academic partners have ongoing projects with relevant federal and state agencies that have resulted in the significant capabilities.

These existing relationships ensure close co-ordination of the Center’s efforts among a diverse and yet highly complementary group of researchers. These resources and capabilities will be applied to the Center’s following goals: improving the security of marine transportation and coastal and offshore operations and leveraging security investments also to improve economic performance; improving emergency response to events in the maritime domain; and improving the resiliency of the MTS, offshore operations and our nation’s coastal environments.

The technologies, systems and procedures that will emerge from CSRM will be transformational. For example, sensors, models and systems under development by the partners for coastal environment observation and forecasting can be converted into a dual-use network that provides Maritime Domain Awareness in the coastal and maritime approaches of the entire Exclusive Economic Zone (EEZ) and extending to the high seas. These and other opportunities for leveraging existing investments to achieve both security and economic transformational progress for the nation and for its maritime businesses will be pursued.

All CSRM research and technology development activities will be guided by a spiral-development approach to solving the complex issues facing the global MTS and our coastal communities. This approach will require that the CSRM research projects achieve the necessary fidelity to provide improved understanding and capabilities, as well as technology products where possible, that can be examined via full-scale experiments and exercises in the real-world environment (initially conducted within the New York-New Jersey Harbor region). These activities, rooted in basic research and new knowledge development, will lay the groundwork for the transitioning of new technologies, systems and policy recommendations to full implementation.

The research agenda will remain flexible as the Center develops and refines the research plan, with the agility to respond quickly to new and emerging threats and national needs. Throughout, the member universities will involve undergraduate and graduate students, and will develop new courses, new curricula, and professional education and outreach tools to facilitate the training of the next generation of maritime security and coastal safety professionals.

Resilience is the ability of a system to provide and maintain an acceptable level of service in the face of various faults and challenges to normal operation, including natural disasters, unexpectedly high demand peaks, malicious attacks, worker strikes, operational standstill in the face of terrorism threats and other potential disruptions of service.

The development of simple yet effective methodologies that ports can use to evaluate their resilience and strategies for port authorities to improve their resilience is essential, both focusing on technological systems and service delivery as well as on the organisational level.

In order to create resilient infrastructures, it is imperative that ports are seen as a network of physical nodes with multiple layers that include freight processing units in foreign ports, customs and immigration, and other freight information systems.